THURSDAY, DECEMBER 10, 1914.

RELATIVITY.

The Theory of Relativity. By Dr. L. Silberstein. Pp. viii + 295. (London: Macmillan and Co., Ltd., 1914.) Price 10*s.* net.

THE appearance of a connected account of the Principle of Relativity in our own language will be welcomed by many as an opportunity of acquainting themselves in more detail with the ins and outs of a controversial subject. The note of controversy is, however, almost completely absent from this book. There is scarcely a reference to the longings of the physicist for an objective æther, save the sentence, "Lorentz had not the heart to abandon the æther which he confessedly 'cannot but regard as endowed with a certain degree of substantiality.'" The readiness to "abandon" well-worn concepts and old-established theory is becoming a marked feature of the thought of physicists to-day. We are witnessing at this moment a revolutionary movement in the 'quantum theory' which at times seems to forget entirely the classical electrical theory, and all the wealth of experimental evidence out of which it grew. In the same way the exponents of the principle of relativity have found delight in pouring contempt on the æther as the basis of electromagnetic influence, while in their turn the more conservative of physicists, failing to see how natural was the transition from Lorentz' theory of optical and electromagnetic phenomena in moving bodies to the novel point of view of Einstein, seized upon the somewhat artificial system of clocks by which the latter sought to make his meaning clear, and found in it a laughing-stock.

It is strange that there has been so much difficulty in making the fundamental point of view of this theory clear to those whose interests are experimental rather than theoretical. Many will read Dr. Silberstein's careful and detailed introduction to it, consider his illustrations, and follow his logic, and yet feel there is something lacking. The 'argument from need' for an æther is not dealt with. The reluctance that Lorentz had to abandon the æther remains. The seeker after a deeper understanding of the physical is apt to fight shy of a principle which cannot be expressed in terms of concepts to which he can give some 'degree of substantiality.' A systematic exposition of the principle of relativity necessarily consists very largely in the demonstration of invariant properties of certain mathematical relations. Hence it is almost bound to appear a little uninteresting to the experimentalist. Dr. Silberstein compresses the purely mathematical discussion, and judiciously separates it from the general and descriptive account as far as possible. He shows how many of the invariant relations fall simply and naturally into quaternionic form. But little is done to remove the unfortunate impression that relativity is a fad of the mathematician, and not a thing for the every-day physicist. It is to be feared that many will turn to this book full of hope, and come away from it feeling that the subject is barren for the future. For the universe is not compact of quaternions or matrices. As a physical principle, the principle of relativity needs to be placed in its relation to other great generalisations, such as the conservation of energy and momentum, and the status of the fundamental concepts of space and time in mathematical physics needs to be clearly realised.

The present book gives an adequate supply of material for meeting these needs; the account of the developments which led up to Einstein's work is useful and clear; but the reader will need imagination and sympathy if he is to find here an answer to the many difficulties which the subject raises.

PRACTICAL CHEMISTRY.

(1) *The Elements of Qualitative Chemical Analysis.* By Prof. Julius Stieglitz. Vol. i.; Fundamental Principles and their Application. Pp. xi + 312. Vol. ii.: Laboratory Manual. Pp. viii + 153. (London: G. Bell and Sons, Ltd., 1914.) Price 6*s.* net each volume.

(2) *Introduction to Modern Inorganic Chemistry.* By Dr. J. W. Mellor. Pp. xvi + 684. (London: Longmans, Green and Co., 1914.) Price 4*s.* 6*d.*

(3) *Allen's Commercial Organic Analysis.* Vol. viii. Fourth edition. Entirely re-written. Edited by W. A. Davis and S. S. Sadtler. Pp. x + 696. (London: J. and A. Churchill, 1914.) Price 21*s.* net.

(4) *Handbuch der Arbeitsmethoden in der anorganischen Chemie.* Herausgegeben von Dr. Arthur Stahler. Dritter Band. Erste Hälfte. Pp. x + 692. (Leipzig: Veit and Co., 1913.) Price 22 marks.

(5) *Quantitative Analysis by Electrolysis.* By A. Classen. With the co-operation of H. Cloeren. Translated from the thoroughly revised fifth German edition by Prof. W. T. Hall. Pp. xiv + 308. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1913.) Price 10*s.* 6*d.* net.

(6) *Anleitung zur Darstellung Phytochemischer*

Uebungspräparate. By Dr. D. H. Wester. Pp. xi+129. (Berlin: Julius Springer, 1913.) Price 3.60 marks.

(1) QUALITATIVE analysis still forms the beginning of all instruction in chemistry, but in its modern form it no longer takes the guise of the familiar tables, supported by the test-tube rack and the shelf of reagents. Indeed, at the hands of the more advanced apostles of physical chemistry it has been altered beyond all recognition, and it is from this point of view that we must criticise the new contribution of Prof. Stieglitz to the literature. The method of instruction advocated by him aims at developing the critical searching mind of the professional productive chemist. The students taking his course are supposed to have been prepared in general chemistry on physico-chemical lines.

In part i. of the new work the student is started off on fundamental principles, and he is involved at once in the consideration of osmotic pressure, theories of solution, ionisation, chemical and physical equilibria, as a preliminary to undertaking the systematic analysis described in part ii. For those few students who can stand it the treatment is admirable, but it demands teaching of the very highest class to make it at all successful, as well as very great concentration on the part of the student.

The second volume is entirely a laboratory manual devoted to the study of reactions and systematic analysis. The text, which is interleaved with blank pages, consists of a series of instructions of the usual type with the variation that the "ionic phraseology" is used throughout.

From the point of view of those who follow the new school the book is one of the best of its kind —whether it will help to produce another Hoffmann or Faraday, or what is as important, a Mond or a Muspratt, is more open to question.

(2) Dr. Mellor's "Modern Inorganic Chemistry" has already won a place on the shelves of most chemists, so that his new introduction, written from a more elementary point of view, should need no external recommendation. The author's statements as to what a student may expect from a general course of chemistry are worth quoting even at a risk of repetition, as too many of the modern text-books have already the opposite tendency. They are:—(1) Skill in observation and experiment; (2) memory and knowledge of relevant facts; (3) ability to reason and think in a logical, systematic way; (4) cultivation of the imagination; (5) development of a critical and impartial judgment.

The finished student with these attributes would not seek long for a lucrative position.

(3) The volume under notice completes the new edition of this well-known work, though we understand that a supplemental volume bringing the whole work up to date is in course of preparation. The articles on the analytical examination of the proteins are written by eleven authors whose names are sufficient guarantee of the completeness of the sections. It would be easy to quote small details where errors or omissions had been made, but it is fairer to comment on the vast mass of information which the volume contains and to praise the industry which has gone to its making, the more especially as such work is well known to be largely a labour of love. The new edition of Allen's work will more than maintain the reputation won by its forerunners.

(4) Dr. Stahler's work is an example of the modern omnibus type of German dictionary, full of every possible detail, and no doubt of the utmost value. The facts that it is very costly, so large as to make search in it a matter of difficulty, that it is published spasmodically in any sort of order, and contains a great amount of padding, all militate against it being found outside a few large university libraries. Furthermore, like so many recent German works, it tends to ignore much of the work done outside Germany, and so sacrifices any claim to completeness.

(5) It will be generally admitted that not the least of the advantages derived from the modern advances in electro-chemistry are the many valuable methods of analysis which have been based on them. In particular many of the methods are in use in those cases where speed is essential.

Prof. Classen's German text, which was published originally as long ago as 1882, is very widely known, and has passed through several editions. Prof. Hall has done a considerable service in bringing the English edition again up to date. The table of contents illustrates sufficiently how widely electro-analytical methods are applicable both to the more simple operations, such as the separation of metals from one another, and also to more special technical analysis, such as that of commercial copper, zinc, lead, and their ores. All the more recent new methods are included, and the apparatus required is fully described and figured.

(6) The danger of extreme specialisation has been emphasised often enough, but so exaggerated is this now becoming that we are offered from Germany a special course of phytochemical preparations picked out for the would-be botanist. A selection of organic compounds which are in some way connected with plants is made, and the manner of their preparation described in some

detail, so that the student can make them in the laboratory and gain an idea of their individual properties.

There will be no difference of opinion amongst teachers as to the futility of such a plan. The student can get no proper idea of chemistry as a subject, or of its theories and application. He will regard it merely as a series of manipulations, and his text-books as akin to cookery books.

At a time when the teaching of chemistry to medical students is steadily improving it is disconcerting to notice a tendency in the reverse direction in the case of biological students, which unhappily is not confined to the Continent.

MATHEMATICAL BOOKS: ELEMENTARY AND ADVANCED.

(1) *Arithmetic.* By H. Freeman. Pp. viii+231+xxxi. (London: G. Bell and Sons, Ltd., 1914.) Price 2*s.* 6*d.*

(2) *The School Algebra.* By A. G. Cracknell. Pp. viii+568+lxxvii. (London: University Tutorial Press, Ltd., 1914.) Price 5*s.*

(3) *Statics.* By R. C. Fawdry. Part i. Pp. vii+165. (London: G. Bell and Sons, Ltd., 1914.) Price 2*s.* 6*d.*

(4) *A First Schol Calculus.* By R. Wyke Bayliss. Pp. xii+288. (London: E. Arnold, n.d.) Price 4*s.* 6*d.*

(5) *A Treatise on Differential Equations.* By Prof. A. R. Forsyth. Fourth edition. Pp. xviii+584. (London: Macmillan and Co., Ltd., 1914.) Price 14*s.* net.

(6) *Linear Algebras.* By Prof. L. E. Dickson. Pp. viii+73. (Cambridge University Press, 1914.) Price 3*s.* net. Cambridge Tracts in Mathematics and Mathematical Physics, No. 16.

(7) *The Elements of Non-Euclidean Geometry.* By Dr. D. M. Y. Sommerville. Pp. xvi+274. (London: G. Bell and Sons, Ltd., 1914.) Price 5*s.*

(8) *A New Analysis of Plane Geometry, Finite and Differential, with numerous examples.* By A. W. H. Thompson. Pp. xvi+120. (Cambridge University Press, 1914.) Price 7*s.* net.

(1) THIS book consists mainly of examples, and there is said to be "just sufficient bookwork to be of use to a pupil when in difficulty." We do not think that, for example, any difficulty a pupil may feel about negative numbers can be dispelled by a complete absence of "bookwork" about them (p. 7).

(2) The aim of this book is to bring the teaching of elementary algebra into closer touch with "intelligible" calculations, and also to give a clear account of the elements of algebraic theory. The author warns us that "a rigorous logical account of the fundamental laws of algebra is very difficult, and would be quite out of place in a book of this description." Accordingly, we find, on p. 172, that "*the* negative unit" is defined as "*a* unit which cancels a positive unit" (the italics are ours). In this confusion between definite and indefinite articles, there seems to be some departure from the author's intention to give a clear account of things. The author seems to recognise that such things as the law of signs does present difficulties, but his treatment is not satisfactory. The book is not without merits.

(3) This pleasant little book shows the very healthy influence that the work of Mach has exerted on the teaching of mechanics. It deals with the subject on an experimental basis, and contains many examples, mostly numerical.

(4) This is an attempt to introduce the calculus by means of simple questions based upon matters familiar to the student either from his every-day experience or from his work in the laboratory. It is said to be "planned upon the latest educational theories," but this ought not to prejudice us against a very sound book which contains none of the subtlety that is required in higher walks of mathematics. For example, on p. 153, under the stimulating heading of "The Borderland of Discovery," the introduction of new functions by integration is treated apparently on the principle that any combination of symbols whatever must mean something. This is rather a natural supposition for most budding mathematicians to make, but it would be as well to warn them of possible dangers.

(5) The third edition of this well-known and solid work was published in 1903. This fourth edition is larger, but the general scope of the book is unaltered. Prof. Forsyth's object is to produce a working text-book, and the general theory is scarcely touched upon. Thus, such subjects as theorems of existence are noticed only by a reference to the author's "Theory of Differential Equations." There is an advantage, says the author, "even if only of conciseness," in assuming some results of the theory. Some parts of the book have been re-written, particularly the early part of the chapter on the hypergeometric series, and parts of the chapters on partial differential equations. A number of short additions has been made: on ordinary linear equations with some of their integrals of the type called "regular"; on total differential equations; and on partial equations. The only misprint—if, indeed, it is a misprint—that we have been able to find is a reference in the index to Abel on a page where algebraic functions are spoken of, and not Abel. It is perhaps almost inevitable that a text-book on

differential equations should not excite a learner's vivid interest unless it so departs from the logical order as to be historical. Often a modified logical order seems the easiest and most natural order. But the problem of education seems to be rather a problem of awakening interest, and not of choosing "natural" paths. Difficulties cease to matter if one's interest is aroused.

(6) Prof. Dickson's introduction to the general theory of linear algebras, including also non-associative algebras, shows in many places the influence of the German "Encyklopädie." The exposition of the main theorems of the general theory follows Cartan and, to some extent, Wedderburn, and is a most useful introduction to the subject.

(7) Here is an excellent text-book for all students of geometry. As seems to be always the case with this subject, the treatment is, to a great extent, historical, but the analytical treatment begun by Riemann occupies a rather minor position. A very welcome feature is that, throughout this book, Euclidean geometry is exhibited as a particular case of non-Euclidean geometry, and the apparent want of symmetry and the occasional failure of the principle of duality are explained. It seems rather confusing to assume tacitly, as the author does on p. 30, that through any point there are in hyperbolic geometry two, and only two, parallels to a given straight line.

(8) This book claims, rather magisterially, to be original. It seems to us more interesting than strikingly original. The equation of a line, $y=mx+c$, may be regarded as having the co-ordinates m and c. By using the word "measure" to denote a concept including both the distance of two points from one another, the perpendicular distance from a point to a line, and the angle between two lines, it is possible to state shortly what co-ordinate geometry does. This is the reduction of a set of joins and intersections of points and lines to functions of the measures of the elements. This idea is developed by the author and applied also in differential geometry.

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OUR BOOKSHELF.

Quain's Elements of Anatomy. Eleventh edition. Vol. ii., part ii., Splanchnology. By J. Symington. Pp. x+392. (London: Longmans, Green and Co., 1914.) Price 10*s.* 6*d.* net.

IN this further contribution to the eleventh edition of Quain's "Elements of Anatomy" Prof. Symington describes the following systems of the human body:—Digestive, Respiratory, and Urogenital. Two minor sections are devoted to the ductless glands and peritoneum, the latter being written by Dr. P. T. Crymble. During the eighteen years which have elapsed since the tenth edition appeared—under the joint editorship of Sir Edward Schäfer and Prof. Symington—anatomists, physiologists, and particularly surgeons have altered our conception of the splanchnology of the human body in many and important details. These changes are reflected in the text and illustrations of the new edition of "Quain."

No one is better qualified to edit this standard work on human anatomy than Prof. Symington. We feel, however, that in giving the Belfast school its full due, Prof. Symington has done less than justice to those who live and work outside the limits of Belfast. One example will suffice. About twelve years ago a series of observations were made by Keith, Barclay Smith, and T. R. Elliott, which served to show that the contents of the small and great intestine were separated, not by a mechanical valvular apparatus as was formerly supposed, but by a muscular mechanism, similar in the manner of its action to a sphincter. Sir William MacEwen and Dr. A. F. Hertz have demonstrated the existence of an ileo-cæcal sphincteric mechanism in the living human body, and emphasised its functional and clinical significance. Yet in the text of this edition no mention is made of these observations, and the erroneous and antiquated description of a mechanical valve is reproduced. This is the more surprising because the illustrations of the ileo-cæcal junction, reproduced from the former edition, bear out the non-mechanical nature of the ileo-cæcal orifice.

(1) *The Great Ball on which we Live.* Pp. 249. (2) *Our Good Slave Electricity.* Pp. 246. By C. R. Gibson. (London: Seeley, Service and Co., Ltd., 1915.) Price each volume, 3*s.* 6*d.*

MR. GIBSON has attempted with considerable success the solution of the old problem—how to interest children and at the same time instruct them. In the first volume he tells the story of the earth, and invites his readers to accompany him on imaginary visits to our planet before man's appearance on it. The fact that at one place a jelly-fish tells the story of what happened in the sea, and at another a worm records its experiences underground, will indicate the style of treatment adopted.

The second book describes in a similar simple manner some of the achievements of electrical science, and young readers will probably be led by these chapters to take up serious study later.

If it is possible to form sound elementary ideas of experimental and observational science merely by reading, it would be difficult to find more attractive introductions than Mr. Gibson has prepared.

Brown's Marine Electrician: for Sea-going Engineers. By A. E. and A. H. Larkman. Pp. xv+244. (Glasgow: James Brown and Son. Second edition, 1914.) Price 5*s.* net.

IN this book "the authors seek to give practical information on such matters as the installation, repair, and use of electric lighting, heating, and

other appliances suitable for use in ships." Apparently the reader is expected to acquire that information from illustrations which seldom show more than the outside appearance of the apparatus, and often show nothing at all but a cast-iron case! There are some more detailed diagrams, but too many of them refer to machines or apparatus which could only now be purchased in the electrical equivalent of the old clothes shop.

The book will certainly enable the sea-going engineer to distinguish between a search-light and a telephone, or between a dynamo and a switch, but we fear he would be very much at sea when anything went wrong if his knowledge was not a great deal deeper than that in the book.

It may be the printer's fault that a very ordinary Welsh name is given as that of one of the celebrated builders of high-speed engines, and that Mr. Marconi's has been associated with his great rivals. But these errors sufficiently well typify much of the contents of the book.

DAVID ROBERTSON.

Die Insekten Mitteleuropas insbesondere Deutschlands. Edited by Prof. C. Schröder. Band iii. Hymenopteren (Dritter Teil) Die Gallwespen (Cynipidæ). By Prof. J. J. Kieffer. Die Blatt- und Holzwespen (Tenthredinoidea). By Dr. E. Enslin. Pp. xiii + 213 + viii plates. (Stuttgart: Franckh, 1914.) Price 7.20 marks.

THE third part of the third volume of the "Insects of Central Europe," so ably edited by Prof. Chr. Schröder, of Berlin, contains an account of the gall-wasps (Cynipidæ) by Dr. J. J. Kieffer, and of the saw-flies and wood-wasps (Tenthredinidæ) by Dr. E. Enslin. In both cases the systematic description is preceded by an effective introduction dealing with structure, life-histories, and ecology. Thus we find a very clear account of the various theories of gall-formation by Cynipidæ and of parthenogenesis in Tenthredinidæ. The volume is very well illustrated, both as regards the text figures and the coloured plates.

Bartholomew's Orographical Map of Central Europe, showing Political Frontiers. Scale: 31·5 English miles to 1 in. Price 2*s.* 6*d.* net. *Bartholomew's War Map of Europe and the Mediterranean.* Scale: 86 miles to 1 in. Price 1*s.* net. (Edinburgh: John Bartholomew and Co., 1914.)

NOTHING assists an intelligent appreciation of the details of military campaigns more than good maps of the areas concerned. The maps before us are excellent. The first enables the reader of war news to realise the intimate interdependence of strategy and land relief; and the second depicts boldly the present extent of the European territories of the nations at war. Both maps are produced in the workmanlike manner for which the Edinburgh Geographical Institute has long been well known.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Soldiers as Anthropologists.

IN NATURE of December 3 (p. 383) there appeared a brief abstract of a paper communicated by Mr. Reginald A. Smith to the Royal Anthropological Institute on behalf of its author, Major E. R. Collins, D.S.O., now a wounded prisoner of war in Germany. The paper is not only an important contribution to our knowledge of the prehistoric stone implements of South Africa, but is evidence that a brave and capable soldier may, while helping to shape the history of his own time, give material assistance in unravelling the past history of the country through which he may be campaigning.

Major Collins collected the material for his paper while engaged on trenching operations during the late Boer war. These operations extended over a large part of South Africa—from Cape Colony to the Transvaal. The trenches were usually cut to a depth of 5 ft., and often crossed terrace deposits, which are presumably of Pleistocene age. It was whilst engaged on these operations that Major Collins made his collection of the stone industries of the ancient inhabitants of South Africa, keeping systematic records of the deposits in which the implements occurred, and the levels at which the various types were found. That Major Collins's interest in anthropology did not interfere with his military duties may be inferred from the fact that he earned the Distinguished Service Order.

Mr. Reginald Smith has directed my attention to an earlier instance of a soldier utilising military operations for the progress of anthropology. In the Journal of the Anthropological Institute for 1884 (vol. xiii., p. 163) there is a paper, also on South African implements, contributed by Major H. W. Feilden, which was described by the late Mr. Hyde Clarke, vice-president of the institute, as "remarkable for the circumstances under which the information was obtained—on the march, in the battlefield, and through the perils and vicissitudes of war." Major Feilden made his observations during the campaigns in Natal, 1881–82. I have little doubt that some of our French colleagues, amidst all the dangers and anxieties which attend the present war, will avail themselves of the opportunities presented by the extensive trenching operations in northern France to extend further our knowledge of prehistoric times.

I have headed this note "Soldiers as Anthropologists," but I may be pardoned if, at the present time, I direct attention to another side of the matter, "The Anthropologist as Soldier." In a letter I had lately the honour to receive from Prof. Manouvrier, secretary to the Society of Anthropology of Paris, I was grieved to learn that "Nous avons perdu en France un anthropologiste archéologue des plus estimés, M. Déchelette, capitaine de territoriale, tué dans une charge à la tête de sa Compagnie." M. Déchelette was author of a standard work, "Manuel d'Archéologie préhistorique Celtique et Gallo-Romaine," the third volume of which appeared during last year. M. Déchelette did not allow either his past or present services to science, his family ties, or his age—he was fifty-nine—to stand between him and what he considered his duty to his country. Although a great number of its members—including many of the most eminent anthropologists in Europe—are on active service—some have fallen, some wounded, and

others decorated for bravery in the field—the Société d'Anthropologie still continues its meetings. I was able to inform Prof. Manouvrier that the sister society in London, in common with other English scientific societies, also continued its meetings, that many of its members—including the honorary secretary and assistant-secretary, had volunteered for active service, and that a member of the council (Major S. L. Cummins) had been decorated with the Legion of Honour.

"Pour moi," writes Prof. Manouvrier, in concluding his letter, "je ne puis plus qu'un vétéran—un ancien volontaire de 1870. Je fus ainsi un très obscur compagnon d'armes de notre aimé Lord Kitchener."

Royal College of Surgeons, ARTHUR KEITH.
Lincoln's Inn Fields, W.C.

A Central Thought of Vector Analysis as used in Physics.

VECTOR analysis is now recognised fully as furnishing standard modes of expression for many ranges of mathematical and physical thought; and meanwhile, the atmosphere of the physical thought especially is continually reacting upon the newer analytic method, and adapting it with preciser discrimination to the needs of actual use. Thus the dichotomous arrangement of quantities as scalar or vector has been supplemented by the tensor-triplet as a *tertium quid*, vectors are habitually grouped as free or localised, pseudo-scalars have been set off from pure scalars. Something has been done, too, through the influence of ascertained physical connections, toward unifying discrete formal results by appreciating real underlying articulation. Such advances as are made deserve immediate incorporation in the accepted text, as likely to render the methods more widely available; and the serving of that end has suggested presenting the notes that follow.

Most of the orthodox lines of development leave scalar product and vector product isolated from one another, each sharply differentiated by its own special definition. And an impression is then ordinarily felt that the novel characteristics of vector analysis in cutting through the rules of algebra centre upon the vector product. What there may be of exaggeration in this impression can be corrected by very simple and accessible considerations. First we may observe that an axial vector and a vector product are essentially two aspects of the same conception, the former being potentially resolvable into two factors determining an oriented area that is at the same time the geometrical basis of the vector product. But the projection of areas and their graphic representation by their measured normals are familiar elementary notions; while the assignment of "circulation" round the perimeter to an area, being necessary in order to complete the plan of conventional representation, must be expected to appear also in the equivalent vector product. In fact, the rule for sequence of the factors there and the change of sign upon reversal of that sequence are only assignment of circulation scarcely disguised. To establish the connection is to restore the emphasis of Grassmaun's thought where it may have been neglected.

At another point current procedure is apt to dislocate the vector product from its natural or original setting, and encourage a misleading effect of antithesis where there is in reality more nearly a complementary relation. When a scalar product and its corresponding vector product are introduced separately and held apart by exclusive stress upon their divergence of type, an instructive link uniting them is lost sight of or ignored. At their source they are linked in that completer combination of two vectors according to the fundamental idea of multiplication of which they are partial aspects. Again it is Grassmaun who more than hints at this very point of view, presented also in a somewhat different dress by the quaternion and the dyad. For purposes of elementary introduction the relation in question comes, perhaps, most clearly into prominence if the vector factors to be combined are from the outset of this particular development written each as a "semi-cartesian" trinomial, yielding thus nine terms for the presentation of the completed combination. On inspection three of these terms are obviously scalar; they constitute the "scalar product" (or expressed more fully the "scalar side of the product"). The remaining six terms are just as obviously to be accepted as vectors in their nature; together they constitute the "vector product" (or the complementary "vector side of the product"). These mutual complements make up the complete expression into which they enter, though they cannot coalesce, very much as a complex quantity contains a real term and a detachable imaginary term.

The value of the more inclusive statement is to be rated still higher in its justifiable extension to the combination of Hamilton's operator with a field-vector, which is also expressible formally as the expanded product of two trinomials, the nine terms of which, here too distinguishable as scalar and vector to unstrained interpretation, are presently grouped under the headings "divergence" and "curl." For the complete combination that might be written $(\nabla\mathbf{v})$ is intended to place in our hands by its results a means of specifying with all reasonably attainable detail the local peculiarities of distribution for the field-vector. And here the usual partition of the specification into apparently quite disconnected divergence and curl seems plainly artificial at first sight, and becomes yet more so as we trace out the intimately complementary character of the two items in the description. It will always be helpful to emancipate ourselves from the formal constraints of our algebra, which here, for example, in a degree forbid the association of scalar and vector parts, and aim on the contrary, through the choice of orthogonal components, at a segregation at once complete and reduced to simplest terms. We remember with profit that one main office of the vector analysis is to do away with those mechanical features of algebra which contribute nothing or little to the progress of thought. FREDERICK SLATE.

University of California.

Science and National Needs.

IN a recent issue of NATURE (October 29, p. 222) the remark occurs:—

"In this hour of national emergency there is no time to be lost. We cannot all be soldiers, but we can all help, we men of science, in securing victory for the allied armies. Every day lost means the destruction of a number of our fellow-countrymen and of our allies, and the sooner we co-operate for the good of the nation the sooner will the war be over."

Acting upon the suggestion, and bearing in mind the manner in which the dew-ponds on Salisbury Plain suffered during the drought of 1911, I immediately offered my services to the War Office, to advise as to the digging of dew-ponds and the choice of sites for them.

I find that there is not now so great a necessity for them there as formerly, as water has been laid on to many of the camps, but should the necessity arise anywhere that camps are placed, the War Office has my offer before them.

I write this in order to encourage others to do what in them lies. EDWARD A. MARTIN.

285 Holmesdale Road, South Norwood, S.E.

THE SUPPLY OF PITWOOD.

ATTENTION has already been directed in NATURE to the great diminution in the normal supply of pitwood since the beginning of the war. This tends at the moment to raise the cost of coal, and would, if continued, ultimately reduce the output. The official returns[1] show a great decrease in the import of pitwood from foreign countries, but this need cause no alarm so long as the command of the seas is retained. Ample supplies are available in Canada and Newfoundland, and a considerable amount of home-grown timber suitable for use in the mines can be felled during the coming winter.

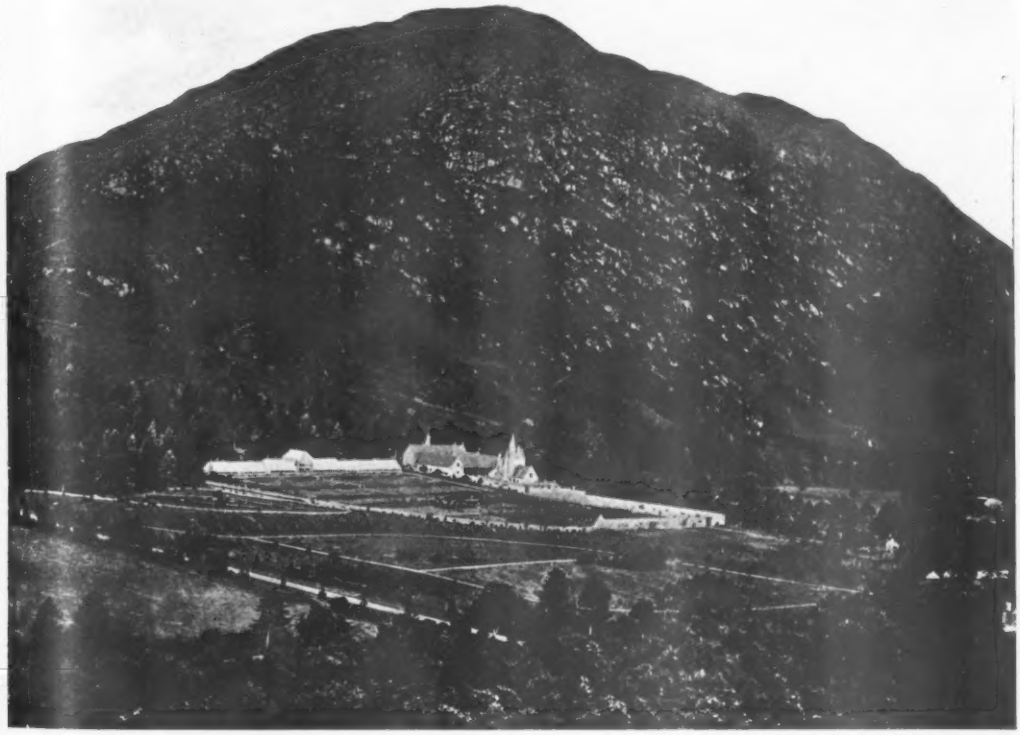

FIG. 1.—A' Cruach before planting. Note the rocky face. From the Transactions of the Royal Scottish Arboricultural Society.

Timber is necessary in coal mines for supporting the roofs of galleries and main roads, for sleepers on the haulage lines, etc. Steel, concrete, and masonry are used in various ways as substitutes, but timber remains the cheapest and most easily handled material.

The great bulk of timber used in coal-mining consists of poles 2½ to 7 inches in diameter at the small end, which are cut into convenient lengths for use as pit props. Such poles are readily procured, either as thinnings or as the smaller-sized trees in woods which are clear felled, and are sold at a cheap rate, being of little value except for utilisation as pit props, firewood, or pulpwood. Both home-grown and foreign timber are used, but the former, of which no statistics are available, scarcely exceeds one-tenth of the total amount consumed. In 1912, a normal year, 260,000,000 tons of coal were raised in the United Kingdom, valued at 118,000,000*l.*, or 9*s.* 1*d.* per ton. During the same year the import from abroad of pit timber was 2,925,000 loads, equivalent to 117,000,000 cubic feet, valued at 3,660,000*l.* In other words, to raise each ton of coal about ½ cubic foot of foreign timber, costing 3⅛*d.* is required. The expenditure on pit props is about 3 per cent. of the price of coal. It is evident that a considerable increase in the price of pit timber could be borne before the cost of coal would rise to a ruinous figure.

There are two classes[2] of foreign pit-timber, the statistics of the import of which in 1912 were :—

	Loads	£
1. Spruce and common pine from Russia, Sweden, and Norway; nearly all from Baltic ports	1,170,000 ...	2,580,000
2. Maritime pine from France, Portugal, and Spain ...	1,189,000 ...	1,039,000

[1] Import of pitwood from foreign countries, 193,002 loads in September, 1914, against 479,515 loads in September, 1913. The figures for the nine months ending September 30, 1914, are 1,920,000 loads; for the same period in 1913 as much as 2,505,459 loads

[2] A small quantity, 26,000 loads, from Germany and other countries is not included in the above figures.

As soon as war was declared, the supply from the Baltic practically ceased, as pit-timber was declared contraband by Germany, and its exportation prohibited by Russia. The supply from France, Portugal, and Spain, though hindered by scarcity of labour while mobilisation was going on in the Landes, appears to be now normal, as the price at Cardiff, which was 20*s.* per ton in July before the war, after rising to the panic figure of 35*s.* in August, dropped to 21*s.* on October 10. These pit-props of maritime pine are cheap in price, as the vessels which convey coal from Wales to Bordeaux, Lisbon, Oporto, etc., carry back the timber to Cardiff and Swansea as ballast voyage, higher cost of labour, etc. As soon as an equitable price is fixed,[3] we may expect adequate supplies of mining timber to arrive from Montreal, Quebec, Halifax, etc. In case of need, further supplies are doubtless available from British Columbia.

Home-grown mining timber consists chiefly of larch, spruce, and Scots pine, either grown in districts near the collieries, or obtained from the Highlands of Scotland and Ireland, the latter country sending last year about 50,000 tons of larch, a good deal of which is used in the pits of Lancashire. A small quantity of inferior timber, in the form of branch wood, coppice, etc., of

FIG. 2.—A' Cruach 32 years after planting with Douglas fir. (Altitude 54–1000 ft. above sea-level.) From the Transactions of the Royal Scottish Arboricultural Society.

at a nominal freight-charge, often as low as 4*s.* 6*d.* per ton. The Welsh collieries will probably continue to receive regular supplies from France, Spain, and Portugal, but these countries will have no surplus timber to send to other colliery districts in England and Scotland.

It is well known that an abundance of timber suitable for pit-props is available in the vast forests of Canada and Newfoundland. Representatives of the Board of Trade, who were conferring on October 1 with the Dominion Minister of Trade at Ottawa, ascertained that the only difficulty is the question of price. It is not possible to obtain Canadian pit-props at as cheap a rate as the Baltic product, on account of the longer sea-

broad-leaved species, like elm, sycamore, and beech, is also used from local sources; but it is disliked by miners, who prefer to handle coniferous poles, which are light in weight and smooth on the surface, besides being very strong. Oak, on account of its great strength and durability, is used in mines for special purposes, but in no great quantity.

In the present urgent necessity, the supply of native pit-timber can be greatly increased for one or two years at any rate. Once the price offered reaches a certain point it will be advisable for

[3] To encourage shipment of pit-timber, vessels from Canada are now allowed by the Board of Trade, as an emergency regulation, to carry unrestricted deck-loads of timber.

owners of coniferous plantations to execute moderate thinnings that will yield pit-props of useful sizes. The present time also affords an excellent opportunity for the clear-felling of unprofitable woods, that is, of all those which are not in a thriving state, or which are insufficiently stocked, or which are over-ripe, and no longer increasing in volume at an appreciable rate. A considerable area of coppice, which has been nearly worthless for some years past, owing to the constantly declining prices of all kinds of small timber, should also be cleared, and be converted into conifer plantations. All such clearances would provide a good deal of timber useful in the present crisis, which was formerly impossible to sell, owing to the abundant supply at a cheap price of the same kind of timber from the Baltic. After the trees are felled, re-planting with fast-growing conifers (as a general rule) should be proceeded with at once. All these operations, felling, planting, etc., would give rise to much employment of labour in country districts during the coming winter, and help to check the migration of the unemployed into the large cities.

Reasonable schemes of State afforestation have hitherto been regarded unfavourably by those in authority, but this view may change after the war is over. Meanwhile, during the present time of national danger, a great deal of useful work can be done by private owners of woodlands on the lines suggested above. There is little doubt that plantations, which can be made out of the proceeds of the sale of pit-timber besides increasing the employment of labour, will prove a safe investment.

What is possible in the way of afforestation in Scotland is the chief subject discussed in Transactions of the Royal Scottish Arboricultural Society (vol. xxviii., part 2), which has recently appeared. This part, besides some useful articles and notes on Douglas fir, Sitka spruce, acetone, etc., gives an account of a tour of inspection of the woods and afforestable lands of the Highlands, made during last July, to which foreign [4] and colonial representative foresters were invited. The splendid results obtained by modern methods of forestry in Perthshire, Deeside, and Strathspey were much admired. The enormous area of land suitable for afforestation was the main feature noticed in Inverness-shire and Argyllshire.

As an example of what can be done in a short period of years, the Benmore plantations on the Clyde are most remarkable. Here 2000 acres were planted thirty-four years ago, mostly on steep and rocky hill-sides, from sea-level to 1200 ft. altitude, the soil being a poor sandy peat covered with heather.

The species cultivated are mainly Douglas fir, larch, Thuya gigantea, Scots pine, and spruce; and the average volume per acre is about 3400 cubic feet, *i.e.*, an annual yield of 100 cubic feet of timber. One detached small plantation of Douglas fir and Thuya, situated at a low level, under 130 ft. altitude, was blown down in 1912, when it was thirty-five years old, and yielded the enormous volume of 7430 cubic feet of timber per acre, which was actually sold for 130*l*. The cost of planting, loss of grazing (5*s*. per acre), rates, taxes, expenses of management, with compound interest at 3 per cent. added, amounted to 61*l*., so that this plantation gave a net profit of 69*l*. per acre at the end of thirty-five years. The owner of the estate, Mr. H. G. Younger, stated that the whole glen, if afforested in the same way, which could easily be done, would support an extra 1000 families by the employment that would necessarily arise. Fig. 1 shows the mountain of A'Cruach at Benmore with its bare rocky face before planting was done, and Fig. 2 shows it covered with forest trees. Both illustrations are from the Transactions of the Royal Scottish Arboricultural Society, and are here reproduced by the courtesy of the Society.

A. H.

[4] Dr. P. E. Müller, the great authority on Forest Soils, was the delegate from Denmark. His views concerning the succession of soils and of species of trees in the Danish forests form the subject of an article in the Transactions, p. 241, which is of interest to plant ecologists as well as foresters.

WOOKEY HOLE.[1]

WOOKEY HOLE is situated in a narrow ravine on the south side of the Mendips, two miles from the cathedral city of Wells. Those familiar with the labours of the pioneers who discovered the presence of man in Pleistocene deposits of British caves need no introduction to this ravine in the Mendips, for the hyæna den, where Prof. Boyd Dawkins, the doyen of British "cave-hunters," commenced his labours fifty-five years ago, is situated on its eastern side, within stone-throw of the main series of caves which open on the ivy-covered crags at the northern or blind end of the ravine.

At the time when Prof. Boyd Dawkins (in partnership with the late Rev. T. Williamson) was commencing his early exploration of the hyæna den (1859), Pengelly and Falconer were bringing their exploration of the cave at Brixham to a close and were in a position to prove that the earlier discoveries made by the Rev. J. MacEnery at Kent's cavern and by Schmerling in the caves along the Meuse were true—namely, that man had been a contemporary of extinct animals such as the mammoth and woolly rhinoceros. Prof. Boyd Dawkins's explorations in the hyæna den at Wookey Hole clinched the matter; man had been living in England in the Pleistocene period. It is also worthy of remark that at the very time Prof. Boyd Dawkins was at work at Wookey Hole, Lartet was exposing, in the strata and hearths of the cave at Aurignac, human bones mingled with the charred remains of extinct animals and certain types of human implements—now recognised as characteristic of a period of Pleistocene culture.

In 1887, Mr. Henry Balch, the author of the work now under review, one to which artist, engraver, printer, and bookbinder have given of their best, began to make further explorations in

[1] "Wookey Hole: Its Caves and Cave Dwellers." By H. E. Balch. Pp. xiv + 268. (London: Humphrey Milford, Oxford University Press, 1914.) Price 25*s*. net.

the hyæna den, and afterwards transferred his labours to the main caverns which open at the head of the Wookey Hole ravine. In the vestibule or passage leading to the first of the three great caverns (see Fig. 1) he found a deposit on the floor amounting in thickness to nearly six feet. The main part of this work is an account of the exploration of this deposit. It is clear from the author's account that the vestibule or entrance had been used as a habitation by man during two periods. The more superficial or recent layers contained pottery and implements belonging to the period of the Roman occupation; the deeper strata were marked by objects belonging to a pre-Roman period—one which reaches back, in Mr. Balch's opinion, to ancient Bretons. He elaborates a tragic short story of a goat-herd to explain the discovery of part of a human skeleton, the skulls of two goats, an earthenware pot, a tethering stake, and a deposit of goat manure in the strata and recesses of the cave floor (see Fig. 2).

Mr. Balch suspects the cave-dwellers of cannibalism (1) because stray human bones were found in the strata of the cave, mixed with animal bones, and (2) because some early writers have alleged that the ancient British were cannibals. None of the bones showed the least mark of human workmanship—of knife or of saw; the fractures which Mr. Balch figures are those which may be seen in human bones dug from modern graves—fractures produced by the grave digger's spade. If

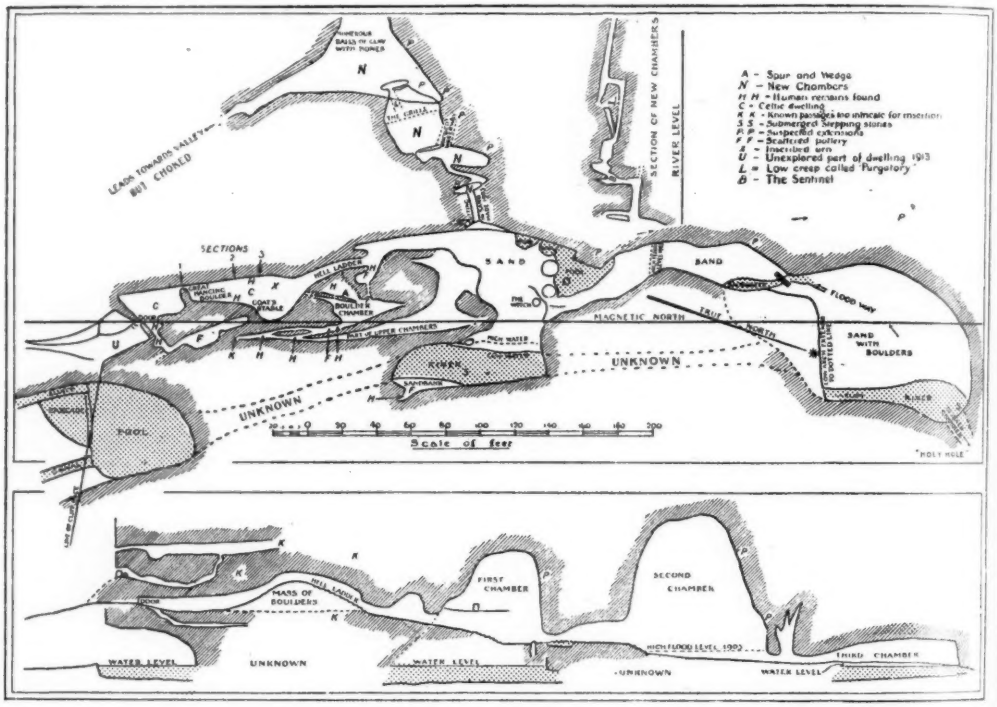

FIG. 1.—Wookey Hole Cavern. Plan and Section by H. E. Balch and R. D. R. Troup, 1912. From "Wookey Hole: its Caves and Cave Dwellers."

about 400 B.C. The pottery, implements, ornaments, and objects of culture, found in the deeper strata are identical with those revealed by the investigations at Glastonbury. It is evident that the cave was used as a habitation when the neighbouring lake-village of Glastonbury was in existence.

Mr. Balch describes and figures in full detail all the traces left by these ancient pre-Roman inhabitants of Somerset. He has brought his imagination to bear on all the details and sought to reconstruct the home life of the cave-dwellers—ably seconded by the pencil and brush of Mr. John Hassall. He pictures the arrival of these cave-dwellers from Brittany, in order to explain the similarity of their cave pottery to that of the human bones are found scattered in the floor-strata of a British cave there is no need to suspect our ancestors of cannibalism. Nothing is better known than that Neolithic people used caves as sepulchres. We know, too, that rabbits and all sorts of animals which frequent caves, scatter the bones of skeletons embedded in the floor. Mr. Balch himself discovered a small cave in the heights above the Wookey Hole ravine; he relates how the human remains on the floor of that cave had been dismembered and spread by the animals frequenting the cave. No; Mr. Balch must bring more convincing evidence to convict the cave-dwellers of Wookey Hole of cannibalism.

Mr. Balch, with justice, dedicates his book to

Prof. Boyd Dawkins, who contributes an introductory chapter, in which he fights gallantly for opinions and conclusions put forward fifty years ago. In the opinion of the veteran geologist of Manchester we have not yet discovered a specimen of the people who lived in the caves of the Mendips during the Pleistocene period. The human skeleton discovered in Gough's cave at Cheddar he regards as an interment of the Neolithic period—whereas those who have investigated the evidence relating to the antiquity of the Cheddar man have formed an entirely opposite opinion—namely, that he represents a race which inhabited Somerset during Pleistocene time. Through the kindness of Prof. Fawcett of Bristol the writer of this note had an opportunity of examining two human

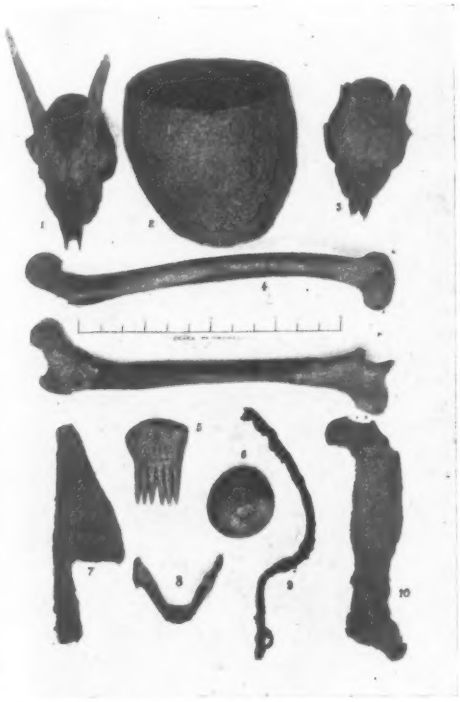

FIG. 2.—Relics of the Goat Head. From "Wood and Cave Dwellers."

skulls dug from the cave earth beneath the stalagmite of one of the Mendip caves. All the circumstances attending their discovery show that they are Pleistocene in age. What is more to the point is that they are exactly of the same form and show the same characteristics as the Cheddar skull. More interesting still, those ancient cave men are apparently of the same race as the early Neolithic people of England. Those who are following closely the progress of our knowledge of the ancient inhabitants of Britain expect much from the caves of the Mendips, and from hints dropped by Mr. Balch in this work, we have every reason to expect that these hopes will be realised. A. KEITH.

NOTES.

DR. C. S. SHERRINGTON has been elected Fullerian professor of physiology at the Royal Institution for a term of three years, the appointment to date from January 13, 1915.

WE regret to see the announcement of the death, at eighty-nine years of age, of the Rev. Sir John F. Twisden, formerly professor of mathematics at the Staff College, and also for forty years one of the professional examiners in mechanics to the Department of Science and Art, and afterwards to the Board of Education.

IT is reported from Paris that Prof. A. Calmette, director of the Pasteur Institute at Lille, who resumed service at the beginning of the war in the capacity of Medical Inspector of Colonial Troops, is a prisoner at Munster, in Westphalia. Should any readers of NATURE have news of other men of science who are interned or prisoners on account of the war, perhaps they will send it to us for publication.

THE European war has unexpectedly checked scientific exploration in South America. Dr. W. C. Farabee, the leader of the University of Pennsylvania's expedition up the Amazon, has sent home word that he has had to cut short his journey owing to the fact that "the lack of funds, due to the uneasiness over the European war, made transportation difficult." The party had, however, already travelled about 4000 miles, and made some valuable anthropological collections.

THE eleventh award of the Reuben Harvey Memorial triennial prize will be made on July 1 next. The prize will be awarded to the writer of the best essay, on a subject to be selected by the candidate, showing original research in animal physiology or pathology, the essay to be illustrated by drawings or preparations. The competition is open to all students of the various recognised schools of medicine in Dublin, and to graduates or licentiates of the medical licensing bodies in Ireland of not more than three years' standing. The essays must be sent on or before June 1 next to the registrar of the Royal College of Physicians of Ireland, Dublin.

THE next meeting of the American Association for the Advancement of Science and of the affiliated scientific societies will be held in Philadelphia, and will begin on December 28. The retiring president, Dr. E. B. Wilson, of Columbia University, will introduce the president of the meeting, Dr. C. W. Eliot, of Harvard University, and will give the annual address on some aspects of progress in modern zoology. An interesting event of the meeting will be the first assembly of the newly established section of agriculture, which will meet on December 30. The address of the vice-president of the section, Dr. L. H. Bailey, late director of the College of Agriculture at Cornell University, will deal with "The Place of Research and of Publicity in the Forthcoming Country Life Development." A symposium on the general subject of "The Field of Rural Economics" has also been arranged.

THE following are among the lecture arrangements at the Royal Institution, before Easter:—Prof. C. V. Boys, a course of six experimentally illustrated lectures, adapted to juvenile auditory, on science in the home; Prof. W. J. Pope, two lectures on colour photography; Sir J. G. Frazer, two lectures on the belief in immortality among the Polynesians; Dr. H. G. Plimmer, three lectures on modern theories and methods in medicine; Dr. Chalmers Mitchell, three lectures on zoological studies: war and evolution; Dr. Aubrey Strahan, two lectures on London geology; Dr. R. T. Glazebrook, two lectures on aerial navigation—scientific principles; Sir J. J. Thomson, six lectures on recent researches on atoms and ions. The Friday evening meetings will commence on January 22, when Sir James Dewar will deliver a discourse on problems of hydrogen and the rare gases. Succeeding discourses will probably be given by Dr. Dugald Clerk, Prof. A. W. Crossley, Dr. W. S. Bruce, Prof. E. B. Poulton, Rev. A. L. Cortie, Sir Rickman John Godlee, Prof. G. H. Bryan, Sir J. J. Thomson, and other gentlemen.

THE death is announced, at fifty-seven years of age, of Dr. A. Celli, professor of hygiene in the University of Rome. The *British Medical Journal* gives the following account of his career and scientific work:—When still quite young Prof. Celli was appointed to the chair of hygiene at Palermo, from which, twelve months later, he was transferred to Rome. There he continued to work—teaching, investigating, and promoting social legislation—till last May. To his persevering efforts were largely due the sanitary improvements that have been made in the Campagna, and the organised campaign for the suppression of malaria. His scientific work covered a vast extent of ground, including research on the parasites which cause malaria, on cholera, on pellagra, on cerebro-spinal meningitis, on dysentery, on flies as transmitters of disease, on rabies, and many other subjects. He was an untiring worker in the cause of social reform through the spread of scientific knowledge.

THE death is reported, in his sixty-second year, of Dr. John Nisbet, Forestry Adviser to the Scottish Board of Agriculture. Dr. Nisbet was educated at the Edinburgh Institution and University, passing into the Indian Forest Service in 1875. He studied forestry at Munich, taking the degree of Doctor in National Economy. In Burma Nisbet proved himself a sound forester and a brilliant writer. He rose to the grade of Conservator of Forests, retiring in 1900. In 1903 he was decorated with the Kaiser-i-Hind gold medal for public service. His "Burma under British Rule," published in 1901, received high commendation. Dr. Nisbet spent his periods of furlough in studying British forestry and in making extensive tours in Continental woods. He thus proved a valuable coadjutor in the early 'nineties to Sir William Schlich in the campaign the latter inaugurated to arouse in these islands an interest in the forestry problem. Among the most important of Dr. Nisbet's publications of this period are "British Forest Trees" (1893), "Protection of Woodlands" (1893), "Essays on Sylviculture" (1893), "Studies in Forestry" (1894). After retiring from India Dr. Nisbet was appointed lecturer in forestry at the West of Scotland Agricultural College, relinquishing this post in 1912 when he was appointed to the Board of Agriculture. In these posts he devoted himself and his whole energies with an ardour which has not improbably shortened his life. He proved himself, with his wide and ripe experience, gained in many countries, a most valuable adviser and interesting lecturer, and his loss will be severely felt in Scotland by his Department, by the Scottish Arboricultural Society, the Transactions of which he edited at one time, and by many who sought his advice. His later publications included "The Forester" (1905), "Our Forests and Woodlands" (1908), and "The Elements of British Forestry" (1911).

THE death of Emeritus Prof. Campbell Fraser, of the University of Edinburgh, at the advanced age of ninety-five years, removes one who knew the city almost as Scott knew it. Dr. Fraser became professor of logic in the New College, Edinburgh, in 1846, and ten years later he succeeded Sir William Hamilton in the chair of logic and metaphysics in the University of Edinburgh. To the active duties of his chair he added very soon those of the dean of the faculty of arts, and continued to act as dean until his retirement from academic labours in 1891. In the early 'fifties he also edited the *North British Review*, and came into touch with many of the most distinguished essayists and philosophers of the day. He lectured in a simple, clear, unimpassioned style, which did not appeal strongly to the ordinary student, but to those who had philosophical tastes he proved an admirable guide, and retained their affection to the end. Some twenty of his students have occupied chairs of philosophy in Great Britain and the Colonies, and if we include professors in theological colleges the number may be substantially increased. His literary output was considerable, the editions of Locke and Berkeley being of especial value; and no scientific man aiming at a philosophic understanding of the principles of science can afford to neglect Berkeley. As Gifford lecturer in Edinburgh in 1894–5 Campbell Fraser developed a philosophy of theism, based on traditional Scottish lines, but worked out in the broad spirit of the nineteenth century. His interest in science was shown by his becoming, early in his professorial career, a fellow of the Royal Society of Edinburgh, serving as a member of council for a term of years. Long after his retirement he appeared with great regularity at the annual graduation functions of the University, a tall though slightly stooping figure, with lofty head and flowing beard, the typical calm philosopher.

WE regret to learn of the death of Dr. G. B. Guccia, whose work will always be regarded as one of the outstanding elements in the development of recent Italian mathematical science. Living in Palermo, where he was connected with the business of a printer and publisher, it occurred to Guccia in 1884 to start a local mathematical society, and to publish printed accounts of its proceedings. Thus sprang into existence the Circolo matematico di Palermo, with twenty-seven original members, which number

steadily increased; the total in 1908 was 570. By that time the Circolo had completely lost its local character, 319 of the members being non-Italian in nationality. These included 68 from Germany, 41 from France, 14 British, 25 Austro-Hungarians, and 92 from the United States. In 1894 Dr. Guccia was elected professor of geometry at the University of Palermo, and he was also a member of the International Council on the bibliography of mathematics, besides being president of the Italian section. When the International Congress of Mathematicians met in Rome in 1908 a "Guccia medal" was offered for the best essay on the theory of algebraic gauche curves, or, failing that, for some contribution to our knowledge of algebraic surfaces or other varieties. The commissioners, consisting of M. Noether (Erlangen), H. Poincaré (Paris), and C. Segre, recorder (Turin), awarded this medal to Prof. Francesco Severi. While the Palermo Society differs from any similar English institution in the fact of having received frequent grants from the Minister of Public Instruction and from the municipality of Palermo—these grants amounting in many cases to nearly 30*l.* and 20*l.* per annum respectively, still larger subsidies have been given by the founder himself. That the local society initiated thirty years ago should have now risen to the status of an international mathematical society of the first rank is a fitting tribute to the energy and enterprise of Dr. Guccia.

THE editor and publisher of the *Animals' Friend* are to be heartily congratulated on the success of their efforts to provide pads for the withers of cavalry horses at the front. Testimony to the value of these pads is afforded in letters of thanks from four yeomanry officers at the front published in the December number. Equal credit is due to "Our Dumb Friends' League," as reported in the same issue, for their successful effort to raise a fund for the purpose of affording assistance to wounded horses on the field of battle.

ACCORDING to a report in the December number of *British Birds*, bird-marking, under the superintendence of the editor, has been attended with conspicuous success during the past season, one operator having distinguished himself by ringing no fewer than 2521 nestlings. It is true, indeed, that the total number of ringed birds was much more than a thousand short of that in 1913, but this is more than accounted for by the decision to discontinue marking black-headed gulls. The most noticeable case of the recapture of a marked bird is perhaps that of a Sandwich tern ringed in the Farne Islands in July, 1913, and taken on the Ivory Coast in February of the following year.

ACCORDING to an article by Miss D. I. Griffin, the director, in the December number of the *Museums Journal*, the Children's Museum at Boston, U.S.A., has proved a complete success, the daily average of visitors being about two hundred, while on Sundays the attendance has sometimes reached a thousand. Temporary exhibits supplement week by week the permanent collections, and lectures (sometimes taking the shape of a stroll in the grounds) and lantern-slides form part of the programme. Labels are considered an essential feature of the museum, those devoted in the nesting season to temporary exhibits indicating the materials of which nests are composed, the adaptations of these structures to their surroundings, etc. The advisability of labels in children's museums is, however, by no means universally admitted, for in a discussion on a children's room at the Salford Museum, reported in the same issue, two museum officials declared them to be unnecessary, and liable to weary juvenile visitors. It was also questioned whether the chamber at Salford has any right to its title, a strong point being made by one speaker to the effect that the height of exhibition-cases could not possibly be made to suit both adults and children.

THE latest issue of the Bulletin of Entomological Research (vol. v., part 2, 1914) contains, in addition to several valuable systematic papers, a discussion by Mr. R. W. Jack, the Government entomologist in South Rhodesia, on the relation between tsetse-flies and "big game" in that part of Africa. Reviewing the evidence, Mr. Jack is inclined to support the opinion that the tsetse either increases or decreases in numbers, as the large ungulates are allowed either to increase under protective administration, or are freely shot or driven away. The restricted distribution of the species of Glossina suggests that these insects are "very delicately poised in the balance of nature," so that a considerable reduction in the available food supply—such as would be brought about by the disappearance of "big game"—might retard the rate of multiplication; for there is a "great expenditure of substance of the female in the comparatively slow process of reproduction." Were this reduction carried far enough, the tsetse might be unable to maintain its racial survival.

IN the last number of the *Journal of Genetics* (vol. iv., No. 2, 1914) Dr. C. Dobell publishes an interesting "Commentary on the Genetics of the Ciliate Protozoa." Students who are not specialists in the Infusoria can gather from this summary how far the results obtained by Woodruff and other recent investigators have modified the conclusions drawn from the famous researches of Maupas. Dr. Dobell's general conclusions at the end of his commentary will stimulate thought and provoke controversy. He objects strongly to the application of the term "cell" to an infusorian, which he insists should be compared with a whole metazoan, as it is "non-cellular" rather than "unicellular." Study of the Ciliates has convinced him of "the formidable complexity of all biological problems as presented by the Protozoa. . . . No new light has been thrown on the great problems of organic evolution. . . . The facts so far determined could indeed be used with far greater force to support the doctrine of the fixity of species." Biological thought just at present seems deeply shadowed by an oppressive scepticism.

IN a paper on the geology of Bermuda (*Amer. Journ. Sci.*, vol. xxxviii., 1914, p. 189) Prof. L. V. Pirsson concludes that the island is an ancient lava-cone that has been converted into a platform by marine erosion,

the oxidised products of decay being washed seaward as an accumulation over the unaltered lavas. The calcareous deposits added later to the platform go back to Lower Oligocene times. The igneous rocks are described in the same volume, p. 331.

IN the Proceedings of the Liverpool Geological Society, vol. xii (1914), p. 1, C. B. Travis provides an interesting account of the plains of denudation of various ages in Great Britain. Special attention is given to the Cainozoic peneplains of south-west England, and the author believes that the features that have been ascribed in this district to marine erosion result from submergence, subsequent to a general planing down of the surface by subaerial agents. The references to literature are valuable.

A SUMMARY of the weather has been given by the Meteorological Office for the autumn season as comprised in the weekly weather reports for the period of thirteen weeks ending November 28. The mean temperature for the period was generally in excess of the average, but the difference was not more than 0·8° in any district of the United Kingdom, and there was a very slight deficiency in the south-east and south-west of England. The rainfall was deficient over the entire kingdom, the greatest deficiency being 4·60 in. in the north of Scotland, and the least 0·67 in. in the Channel Islands. The largest absolute measurement was 10·70 in. in the north of Scotland and the least 5·42 in. in the east of England. In the Channel Islands 93 per cent. of the average rain fell and the next highest percentage was 85 in the north-west of England and 82 in the midland counties, which was followed by 81 in the south of Ireland and 80 per cent. in the south-east of England. The west of Scotland had the lowest percentage of the average, 63, which was followed by 65 per cent. in the north of Ireland and 67 per cent. in the north of Scotland. The rainy days were everywhere below the normal, the least number being forty in the midland counties, and the greatest fifty-nine in the north of Scotland. The duration of bright sunshine was mostly in excess of the normal; the greatest excess occurred in the south-east of England, where it amounted to about one-fifth of the average.

UNDER the title, "The Ice Storms of New England," Mr. C. F. Brooks has contributed to the Annals of the Astronomical Observatory of Harvard College (vol. lxxiii., 1914) a valuable paper on the theory and conditions of occurrence of the phenomenon known as "glazed frost," or coating of ice formed on trees and other objects by rain congealing as it falls, or by other causes. The data quoted refer more especially to occurrences at the Blue Hill Observatory, Mass. (formerly established by Prof. A. L. Rotch) during the years 1886–1914, together with records from a valley station at Readville and a few kite observations. The conditions which may produce ice storms are arranged in a tabular form; the combinations show that theoretically such storms are possible with the surface air temperature above 0° C., although no considerable storm under that condition was noted at Blue Hill. Several of the cases are carefully discussed, and the author states that a study of some of the details shows that storms may occur with a temperature as low as −13° C.; that it may rain hard or lightly; that the wind may come from any direction; and that the temperature may rise, fall, or remain stationary. Ice storms may be much more local than snowstorms, and their prediction in New England is very uncertain, and, at the same time, scarcely necessary.

THE latest volume of the Proceedings of the Edinburgh Mathematical Society (vol. xxxii., session 1913–14) contains a variety of interesting papers (sixteen in all), among which may be noted one on integral equations by M. Pierre Humbert; one on attractions of spherical and ellipsoidal shells by Prof. A. Gray; notes by Messrs. Taylor and Marr upon an elegant geometrical theorem, apparently first discovered by Prof. F. Morley; and papers by Prof. Whittaker and Mr. A. W. Young on Mathieu's differential equation. Prof. Gibson contributes an appreciative notice of that brilliant geometrician, J. S. Mackay.

IN illustration of a paper on the uses of mathematics by Dr. Samuel G. Barton, in *Science* for November 13, the author has worked through the eleventh edition of the "Encyclopædia Britannica," and has compiled a list of the subjects which have required the use of the symbols of the infinitesimal calculus in their treatment. The result of this inquiry is remarkable. The list contains 104 headings, of which perhaps a quarter refer to pure mathematics. The remainder deal with almost every branch of physics, chemistry, engineering, and meteorology, and as the author remarks, the appearance of "clock" and "sky" and many other entries may surprise even mathematicians. The author invites notice of omissions. Curiously none of the entries quoted appear to cover the important applications of the calculus to modern aeronautical problems. Is this Dr. Barton's oversight, or is the encyclopædia itself defective? Had the author selected a lower branch of mathematics than the calculus, such as trigonometry, the list would have been far greater. It would be interesting to estimate the percentage of articles containing some algebraic formula or equation.

Science for November 20 reproduces the address delivered by Prof. Carl Barus to the American Mathematical Society on the occasion of the one hundred and fiftieth anniversary of Brown University. Under the title, "The Mathematician in Modern Physics," it deals with the changes in the fundamental ideas of physics which have taken place since the author's student days, when Weber's theory of electromagnetic action at a distance was still regarded as a wonderful achievement, although Maxwell's ideas were slowly displacing it. Attempts to extend Maxwell's equations to moving electrical systems started a new epoch, and Michelson's light observations led in turn to the Lorentz-FitzGerald hypothesis of the contraction of a body along its line of motion, and to Einstein's theory of relativity, to which the late Minkowski gave so elegant a mathematical form. In another field Boltzmann shed new light by his definition of entropy, Wien then discovered the "displacement"

law," and we now have Planck's atom of energy, which seems destined to play an important part in all future advance, while matter itself—the indestructible matter of Lavoisier—recedes into the background to consort with such shades as velocity and acceleration.

In a "Sketch of a Generalised Theory of Relativity and a Theory of Gravitation" (B. G. Teubner, 1913; pp. 38) Prof. Einstein, in collaboration with Dr. Grossmann, gives a preliminary account of their attempts to base the whole structure of theoretical physics upon the assumption of an exact proportionality between heavy and inert mass, and consequently upon what Einstein calls "the hypothesis of equivalence." The meaning of the latter is: an observer enclosed in a box cannot decide whether the box rests in a statical gravitational field or is endowed with accelerated motion in a space free of gravitation. This leads to the requirement of universal invariance of a quadratic form in dx, dy, dz, dt with variable coefficients (which determine the gravitational field), instead of the very simple Lorentz-invariant of the "ordinary theory of relativity." Electromagnetic phenomena become entangled with gravitation; constancy of light-velocity is given up, of course; the Maxwell-Lorentz equations for a vacuum assume a generalised and more complicated form. Similar investigations are to be found in Kottler's paper of 1912 (*Wien. Berichte*, vol. cxxi.). There are many other striking consequences of the new theory, which obviously cannot be entered upon here. The "physical part" of the paper is written by Einstein, the "mathematical" part by Grossmann. Their theory, apart from undesirable complications, is far from being complete, since, as the authors themselves confess, they have not been able to find the general group of substitutions for their gravitational equations. We may remark here that, fortunately, there is thus far no urgent need of such generalisations, especially as Nordström's theory of gravitation based upon the "old" principle of relativity satisfies all reasonable requirements.

THE Journal of the Institution of Electrical Engineers for December 1 contains an account of some interesting experiments made at the National Physical Laboratory by Messrs. S. W. Melsom and H. C. Booth on the temperature rise in twin flexible wires such as are employed in ordinary electric light installations for pendant lamps with shades. It was found that, with lamps consuming 55 watts and upwards the temperature rise at the cord grip was in many cases 24° C. or more, that is to say, twice that allowed by the wiring rules of the institution, and high enough to destroy gradually the rubber insulation on the wire and to weaken the silk covering. This was due to heat from the lamp, and was irrespective of any heating of the wire itself due to the current passing. Similar observations were made in the case of flexible wires leading to electric irons, hot plates, etc. The temperature observations were in all cases made by means of minute thermo-junctions placed at the points tested. The results of the investigation emphasise the desirability of periodically renewing these flexible wires without waiting for them to show outward signs of deterioration.

OUR ASTRONOMICAL COLUMN.

DISTRIBUTION OF ELEMENTS IN THE SOLAR ATMOSPHERE.—No. 88 of the Contributions from the Mount Wilson Observatory contains the results of an investigation on the distribution of the elements in the solar atmosphere as given by flash spectra, contributed by Mr. Charles E. St. John. The spectrum used in this research was that which was obtained by Prof. Mitchell during the 1905 eclipse, and the results of the reduction of this spectrum, which have already been published, are here employed as the basis of the statistical discussion here described. The general scheme in this research has been to form numerous groups of lines on a simple plan, each element being considered by itself, and the lines of like solar intensity assigned to it forming the ultimate group. The results of the investigation are considered in relation to the author's previous conclusions regarding the distribution of the elements as deduced from the radial motion in sun-spots, and he draws a series of general conclusions founded on the salient facts shown by flash spectra and displacements in the penumbræ of sun-spots based upon mean values. These are too numerous to be given here, but the author points out that "these facts are all harmonised by the consideration that the vapours of the elements ascend in detectable amounts to different heights, that the lines of any one element originate at depths increasing with decrease of solar intensity, that the enhanced lines are higher than unenhanced lines of equal solar intensity, and that we see into the sun to greater depth at the red end of the spectrum than at the violet." A general summary states that "the resulting distribution shows that H_3 and K_3 lines of calcium are the lines of highest level, followed by the $H\alpha$ line of hydrogen, and that, in the main, the heavy and rare elements occur in detectable amounts only in the lower portions of the solar atmosphere."

PHOTOGRAPHS OF HALLEY'S COMET AND COMETS OF THE YEAR 1911.—In the *Annalen der k.k. Universitäts-Sternwarte in Wien* (vol. xxiii., No. 1) Dr. Joseph Rheden publishes a valuable memoir containing details about the photographs which he secured of Halley's comet in 1910 and other comets in 1911. Several instruments (on one equatorial mounting) were employed, such as an objective of 325 mm. aperture and 3·4 m. focal length, a Voigtländer portrait anastigmat of $f/4{\cdot}5$, with focal lengths of 450 or 225 mm., and, lastly, a Zeiss-Planar $f/3{\cdot}6$ of 110 mm. focal length, and another of $f/3{\cdot}5$ of 100 mm. focal length. The memoir contains a brief description of the details of each of the photographs taken and numerous excellently reproduced plates illustrate the general forms of the various comets photographed. Besides Halley's comet, those of Kiess (*b*), Brooks (*c*), Quénisset (*f*) and Beljawsky (*g*), are discussed. It is interesting to note that attempts were made with two different instruments to record the transit of Halley's comet across the solar disc on May 19, but the weather was not very favourable, and the results not of a satisfactory nature.

STRANGE OBJECTS TRANSITING THE SUN'S DISC.—In scanning the solar surface observers have often remarked that they have seen bright objects passing across the sun's surface, and have concluded that they were meteors in the absence of any other plausible explanation. Attention may be directed to two interesting letters dealing with this subject which are communicated to the *Observatory* for November by Prof. Barnard and Mr. Denning. They put before the reader a large number of instances when such objects were observed, and decide conclusively that these daytime showers are not meteors. Mr. Denning

in a series of conclusions, sums up the reasons why the objects seen were nothing like telescopic meteors, and these are as follows:—They require a longer focus than the sun; they did not move in parallel directions; their general direction agreed with the direction of the prevailing wind; they were objects of irregular shape and light filamentous material; their vagaries of motion while in sight were greatly dissimilar to that of true telescopic meteors seen at night; and, finally, on one occasion Mr. Denning followed them on several successive days and a change occurred in the directions. These showers, they state, are purely local terrestrial events. In most cases they are seeds or the down of various plants carried by the wind at high elevations. In some cases snowflakes are the cause of the phenomenon, whilst insect-swarms, gossamer-threads, etc., are sometimes observed. Prof. Barnard states that at certain seasons of the year they can be seen in abundance when the telescope is pointed within a few degrees of the sun, giving the greatest angle of reflection, and if moving slowly appear like minute stars.

STARS HAVING PECULIAR SPECTRA.—In Circular No. 184 of the Harvard College Observatory Prof. E. C. Pickering publishes an additional list of stars having spectra with bright lines or other peculiarities found by Miss Cannon since the publication of Circular 178, which contained a list of peculiar objects in the course of the work on the new Draper Catalogue. The first table in the new circular gives a list of fourteen stars, six of which are described as new variables. In Table II. a list of thirty-one stars having composite spectra, including twenty-four new double stars, is given, and this brings the number of stars with composite spectra found on the Harvard photographs up to 100. The stars in this table range from magnitude 5·32 to 10·6, and the class of spectrum of the brighter and fainter components, as they have been determined from the general appearance of the blended spectra, are given in each case. In both tables the stars are arranged in order of Right Ascension, with the corresponding Durchmusterung numbers.

EFFECTS OF THE WAR ON SCIENTIFIC UNDERTAKINGS.

SEVERAL international or otherwise co-operative investigations of a scientific kind which were in progress at the opening of the war have necessarily been affected by the naval and military operations and the limitation of usual channels of communication. It is not opportune to state the position of some of these undertakings at the present moment, but various negotiations are proceeding, and it is hoped that a means will be found of carrying on work already well begun. The incalculable loss which scientific research must bear in the suspension of the international fishery investigations was referred to in an article in NATURE of October 22 (p. 201). Reference has also been made (NATURE, October 15, p. 183) to the need for a central bureau for the distribution of astronomical telegrams, as was done before the war by the Zentralstelle at Kiel. A few weeks after that note appeared Prof. Elis Strömgren, director of the University Observatory at Copenhagen, announced that by an agreement made between Prof. Kobold, of Kiel, as publisher of the *Astronomische Nachrichten*, and himself, the management of the Zentralstelle für astronomische Telegramme during the present war has been passed over to Prof. Strömgren. Consequently, all communications for the Zentralstelle should be addressed to him until further notice at the Observatory, Copenhagen.

The work of the Tropical Diseases Bureau in London has diminished since the outbreak of the war owing to the non-receipt of French and German journals; for the bureau exists primarily for the collection of information, chiefly from medical journals, on the diseases of tropical and subtropical climates, and its collation and dissemination within the pages of a journal, the *Tropical Diseases Bulletin*. There is little doubt that such investigations are being hampered in Africa by operations of war, and that they will be seriously interfered with in the future owing to lack of funds now derived both from the home Government and the tropical dependencies of Great Britain.

As to the future of the International Catalogue of Scientific Literature, the report of the council of the Royal Society states that the responsibilities of the society in relation to this undertaking have been a source of anxious consideration since the outbreak of the war. Apart from the question of continuance, the society is faced with serious liabilities in respect of this undertaking as it stands at the present moment. Should the annual amount of the subscriptions from Germany, Austria, Hungary, Belgium, and Poland not be available, as seems certain, at any rate until after the close of the war, this would mean an annual loss of about 1060*l.* in income in respect of each issue, or a total loss of about 4000*l.* on the issues of 1911, 1912, and 1913, after taking into account reduction of expenditure and in sales of trade copies and back numbers. This loss will fall, at any rate in the first instance, on the Royal Society.

Daily Weather Maps.—The Quarterly Journal of the Royal Meteorological Society (October, 1914) prints the subjoined note on the effect of the war on the issue of daily weather maps:—The sudden outbreak of war has a very marked effect upon the compilation and publication of the various daily weather maps. The *Daily Weather Report* issued by the Meteorological Office contained the usual information until July 31, but after that date some of the observations began to be missing, while from August 6 no data have been received from central Europe, and the wireless reports from the Atlantic were altogether discontinued. For several weeks the reports from Scandinavia and Spitsbergen were missing, but these were resumed in September, though reports from Iceland are still absent. The difficulties of preparing the usual forecasts and storm-warnings have consequently been much increased. The publication of the daily synoptic weather maps of Europe, the North Atlantic, and a large portion of North America, which has formed part of the *Weekly Weather Report*, has been suspended from August 2, until the necessary data have been received.

It has been the practice of the *Times* newspaper since 1876 to print each day the previous 6 p.m. weather map. This was continued until August 4, but after that date no further map appeared—no doubt owing to all the available space in the newspaper being urgently required for war information. For the same reason the table of observations from health resorts was discontinued from August 3.

On August 6 the Chief of the U.S. Weather Bureau announced that "owing to the state of war involving the great nations of Europe, the meteorological observations from regions in Europe and Asia, heretofore employed by the Weather Bureau in the construction of its weather map of the northern hemisphere, are no longer received, and the issue of this map will be suspended from this date until such time as the reports can be resumed."

Investigations of the Upper Air.—The effect of the war upon investigations of the upper air so far has only been indirect in the British Isles, but several independent causes have led to the fact that the present year has not been as fruitful of results as

previous years, and the difficulty of getting rubber balloons of really good quality has been greatly intensified by the war. During both 1912 and 1913 between fifty and sixty satisfactory balloon ascents were obtained, but the average maximum height in 1913 showed a distinct falling off compared with previous years. This was due to the balloons, of which the quality and workmanship are of the utmost importance. During the present year, although fresh sources of supply have been tried, the quality of the balloons has still further deteriorated, with the result that in many cases a premature bursting of the balloon has occurred and a maximum height of some five only instead of some fifteen kilometres has been attained. Since the details of the ascents have remained the same, the poor heights reached must be due to defective balloons.

There is an old proverb that misfortunes never come singly. The ascents at Manchester have ceased since the beginning of this year, and a run of persistent ill-luck in the finding and return of the instruments has been experienced; also the station of the Meteorological Office at Pyrton Hill, Watlington, ceased to be available in the spring. The present station is at Benson, about six miles W.S.W. of Pyrton Hill, a place equally suitable, but the compulsory removal of the station dislocated the regular routine work of the investigation during the first half of the year. From these various causes the number of successful balloon ascents this year in the British Isles can scarcely reach twenty-five, since the war has, for the time being, cut off the supply of balloons, and the very poor returns from the first half of the year cannot be made up by an extra number of ascents in the latter part.

It has been an unsatisfactory state of affairs that balloons should have been obtained from foreign firms, but cheaper and better balloons were so obtainable. It is hoped that arrangements may shortly be made for the supply from an English firm.

There is another way in which the investigation may be influenced by the war. In England compressed hydrogen can be obtained cheaply and conveniently in steel cylinders, but in some of our colonies these cylinders cannot be obtained. Failing this source of supply hydrogen is most easily produced from calcium hydride, the free lift of the hydrogen in air being equal to the weight of hydride used. Apparently the calcium hydride can only be obtained in Germany.

There is no information about what is occurring on the Continent. The international days are fixed until the end of the year, but after December, if ascents continue in Germany and Austria, it does not seem likely that we shall know the dates. Also the meeting of the International Committee which was to have been held in England next year can scarcely now take place.

In the investigation of the upper air the value of the individual observations is decidedly increased by a well-planned system of co-operation, but happily there are many problems which may be attacked without such co-operation, and we may hope that the work may go on with equal vigour as in the past, excepting that the necessary funds are not likely to be increased by the heavy expenses due to the war.

International Seismological Association.—The fifth meeting of the International Seismological Association was to have been held early last September at Petrograd, under the presidency of Prince Galitzin. Soon after war was declared, it was announced that the meeting was postponed, and, indeed, with the president a Russian, the secretary a Hungarian, and a committee including Germans, Englishmen and Japanese, no other result could be expected. The formal meeting of the association once every two or three years is not, however, the most useful work carried out under its auspices. The permanent committee of the association, with its headquarters at Strassburg, was engaged in collecting materials that could not fail to be of the greatest service. The compilation of the annual catalogues of perceptible earthquakes and of those registered at distant stations would alone justify the existence of the Association. To all this useful work, there must for the present be an end, and, even if the threads of the organisation are ultimately resumed, there will be a long delay in the issue of the next catalogues, and there will be many imperfections in the lists of perceptible shocks. In the registers of seismological observatories, the effect of the war will probably be less serious, for the network of stations established in the British Colonies and in allied and neutral countries is practically world-wide. The late Prof. Milne's decision to maintain the organisation which he created outside the control of the International Association is thus likely to have most beneficial results.

THE NATURAL HISTORY MUSEUM IN THEORY AND PRACTICE.[1]

DR. GUSTAVE GILSON, director of the Royal Belgian Museum of Natural History, has recently given to the scientific world his views on the general theory of a natural history museum in a magnificent quarto volume. The following is a brief abstract of his conclusions.

A universal museum being obviously impracticable, a regional museum is all that can be attempted, and the "region" must be limited according to circumstances. The collections of the museum must be acquired by systematic observations conducted by one or more officials (*chefs d'exploration*) specially trained for this particular work, and the exploration must include the acquisition not merely of individual specimens, but also of such material, drawings, plans, photographs, and records as are needed to give a full account of the environment. "The museum ought only to accept with suspicion a specimen that has not been collected by its own officials and furnished with data written down at the moment of its discovery."

The museum is not primarily an institution for the dissemination of scientific information among the populace, but a progressve institution dedicated to the advancement of knowledge, free from all pedagogic trammels and from every preoccupation alien to the investigation of nature, and thus playing an important part in the humanitarian mission of the development of natural history: "le musée renseigne, mais n'enseigne pas." Nevertheless, the museum may without being false to its ideals, expound to the people many of the results of its work, and become a valuable teacher in a line, and by methods different from those of the schoolmaster.

The regional museum must preserve collections on a generous scale, but these must be properly kept in suitable storehouses (*conservatoires*) under the constant supervision of trained curators (*conservateurs*). Dr. Gilson makes some strong remarks on the failure of many museums to take due care of their treasures. Besides the main collections there should be others, such as the "comparative" department, containing examples of similar objects from other places for study in connection with those of the region. These specimens may, of course, be acquired by gift or purchase. There should also be a public collection of examples judiciously selected; "here everything useless is harm-

[1] "Le Musée d'Histoire Naturelle Moderne—sa mission, son organisation, ses droits." Extrait des Memoires du Musée royal d'Histoire naturelle de Belgique. By G. Gilson. Pp. xii+256. (Bruxelles: l'Académie Royale de Belgique, 1914.)

ful." Every object must be accompanied by an explanation setting forth its most interesting characteristics, and addressed, not to the unlettered, but to the man of education, who is not a specialist. "Exhibition without explanation is vain and profitless, and causes a justifiable feeling of irritation in every serious intelligent visitor." The colonial museum is another institution which may form a suitable annexe to the regional museum, and should be the result of, and an incentive to, the carrying out of the principle that "exploration should precede exploitation," and, as the author aptly remarks, "the more thoroughly and scientifically the former is done the more profitable will be the latter."

The relations, which should exist between the metropolitan museum and local museums are thus defined. "Certain species represented by only one specimen should be sent to the central museum, in view of the paramount necessity of centralisation. The central museum should, however, only receive these on deposit, and should carefully indicate that they are the property of the local museum. Furthermore, a cast or reproduction of such specimens should be placed in the latter with the label, 'The original is deposited in the national museum.'"

Royal Belgian Museum of Natural History, Brussels. The portion to the right is the old building; to the left is the new south wing; a north wing parallel to it was contemplated, as well as a new central connecting member parallel with the old building on the side remote from the spectator.

The regional museum must of necessity be a State institution, but the relations of the museum with the administrative departments of the State should be as simple and restricted as possible. The actual work of the museum should be controlled by an individual not a committee. "Under the autonomy of a personal head the institution utilises the powers of its direction to the full. If mistakes are made they are temporary; the error is in the personality which is short-lived. On the other hand, under the rule of a committee the work, impersonal in its nature, will be mediocre and sluggish, and the institution will vegetate exposed to the gravest perils; the error is perpetual because it is inherent in the system."

The remainder of the volume is devoted to an account of the Royal Belgian Museum of Natural History at Brussels, its origin, present condition, and future. Its history has been one not unusual in the case of similar institutions: progress impeded by official ignorance, coupled with apathy or opposition; the situation improved on the advent of a strong and enlightened personality who knew how to secure more generous treatment. At present the building consists of an old centre and a new south wing. It was proposed to add a similar north wing and a frontage parallel with the old building, but in present circumstances there does not seem much likelihood of these additions being carried out in the near future.

There are numerous well-printed illustrations, which represent a great variety of specimens and all departments of museum work, and it is a singular fact that, though they bear very directly on the text, they are scarcely ever referred to in it.

BACTERIAL DISEASES OF PLANTS.[1]

THE third volume of Dr. E. F. Smith's work on "Bacteria in Relation to Plant Diseases" deals exclusively with "vascular diseases"—that is, those in which the causal organism advances along the vascular tissues of the plant, completely blocking up the zylem vessels. When compared with the account by Russell under the same title, written in 1892, the present work shows markedly the immense progress made since that date in this branch of botanical study. It is a compilation representing indefatigable labour, and forms, with the preceding volumes, a comprehensive summary of all that is known under the head of bacterial diseases of plants. A feature of the work is the care taken to collect a complete bibliography, and the author's extraordinarily wide knowledge of the subject and the extent of his own observations and research render his critical review of all investigations bearing upon the etiology of the disease of extreme value to other workers in this field. Moreover, the full abstracting of original papers, which are brought quite up to date, and lengthy excerpts concerning methods, technique, and results, fulfil the purpose of enabling the reader to form his own conclusions and emphasise the essential character of the publication as a book of reference.

Each disease described is treated in an exhaustive manner, the same plan having been followed throughout the series. The geographical distribution, history, signs of disease, the etiology and morbid anatomy are all fully considered, as well as the morphological and cultural characters of the parasite, to which great attention is given as a means of identification of the specific organism. A discussion of treatment is usefully included, and a general computation of pecuniary losses is attempted.

The present volume deals almost entirely with

[1] "Bacteria in Relation to Plant Diseases." By Dr. E. F. Smith. Vol. iii., Vascular Diseases (continued). (Carnegie Institution of Washington, 1914.)

diseases affecting tropical or subtropical plants, such as the sugar-cane, banana, sweet-corn, etc., which are of no economic importance in this country. If, however, the cultivation of tobacco is to have any great development in Great Britain, a reference to these pages is indispensable as a guide to the destructive

FIG. 1.—Tobacco-leaf from the hothouse, showing the typical red-brown shrivelled spots of the Granville tobacco wilt. The remainder of the leaf was green. *Bacterium solanacearum* abundant in vascular system of the midrib and in many side veins. Plant inoculated in stem, by needle-pricks, on September 23, 1905, using a pure culture of the North Carolina tobacco organism. Photographed February 20, 1906.

attacks to which this crop is subject, and the conditions which influence its successful growth. It seems also to be substantially proved by the author's own examinations and the weight of evidence which he has been able to accumulate, that the various forms of tobacco wilt, including those described by the Dutch

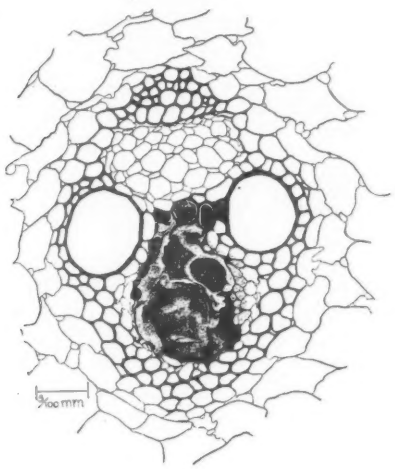

FIG. 2.—*Bacterium vasculare* in stem of sugar-cane received in 1902 from New South Wales. The figure represents a bundle in cross-section. The ground tissue, endodermal sheath, and phloem are still free, also a part of the xylem, including the two big pitted vessels. Sectioned from paraffin and stained with Flemming's triple stain, the contrast being not exaggerated.

and Japanese writers, are due to the same organism, *Bacterium solanacearum*, Smith, which causes the well-known rot of potatoes, tomatoes, and other solanaceous plants. This parasitic disease of tobacco has been known for the last twenty-five years in Japan, and the damage caused is widespread in all countries where tobacco is cultivated; the loss has often been enormous, and many planters have been driven to harvest their crop while unripe and half-grown, in order to save some portion of it.

The specific communicable disease of the sugar-cane, caused by a one-flagellate schizomycete, *B. vasculare*, Cobb, is, so far as is known, confined to this one host plant. It is responsible for a considerable reduction of sugar-content, and is apt to give trouble in the sugar factory, gumming the machinery, and interfering with proper clarification and crystallisation. The disease is most prevalent in the southern hemisphere, and it is satisfactory to learn that it has not been reported from the British West Indies or Porto Rico. It is, however, specially liable to be transmitted in cane cuttings, and planters in these islands are warned to be careful to guard against its introduction. The question of the origin and nature of the "gum," which is such a typical feature accompanying vascular bacterial diseases, is extremely interesting, and it is disappointing to find that nothing has been done on this point since Greig-Smith's work in 1904. His researches, undertaken upon the lines of qualitative chemistry, are entirely confirmatory of the bacterial origin of the "gummosis," as he concludes from tests of the chemical reactions that the "gum" and the bacterial slime from pure cultures on agar are identical. Apparently the mucilaginous substance blocking up the vessels is a bacterial zooglea, but its exact composition has not yet been determined, and remains one of the many unsolved problems of biochemistry. It would seem that these plant-gums are derived by the bacteria from the saccharine contents of the cell-sap, and are clearly not a degeneration product of the cell-wall, as was formerly supposed.

The book is profusely illustrated with excellent photographs and drawings showing all stages of the diseases cited and innumerable inoculation experiments.

M. C. P.

ZOOLOGY AT THE BRITISH ASSOCIATION.

SECTION D held its meetings in the lecture theatres of the Universities of Melbourne and Sydney, and presented a full and varied series of papers. It will be noticed from the subjoined summary that about one-half the time of the section was devoted to the consideration of researches on Australian material.

Recent Work in Antarctica.

A discussion on the past and present relations of Antarctica was arranged by Section D, in conjunction with the Sections of Geology, Botany, and Geography. An account of the contributions of the geologists and geographers to this discussion appeared in NATURE of October 19 (p. 241), so that it is only necessary to refer here to the observations made by Mr. Hedley and Prof. Seward on the biological relations of Antarctica.

Mr. C. Hedley stated that naturalists have deduced the age, climate, contour, fauna, and flora of Tertiary Antarctica from the nature of Antarctic refugees now living in southern lands. For instance—(1) the monotremes, once perhaps numerous, are represented by two widely different types which survive in Australia, Tasmania, and Papua; the bones of other monotremes occur in South American deposits; (2) the Thylacines are recent in Tasmania, and fossil in South America and Australia. Either we must consider that these groups arose independently in each hemisphere, or that they spread from the one to the other. In the latter case a south polar land offered the most direct

path. The simplest explanation of the distribution of marsupials, past and present, is that they originated in South America, spread by way of Archihelenis to western Europe, by way of the West Indies to North America, and by way of Antarctica to Australasia. Turning to the Amphibia, Mr. Hedley pointed out that the families Hylidæ and Cystignathidæ have their chief seat in South America, and both families extend to Australasia, where they are best developed in the south-east and gradually vanish before reaching the Moluccas. In these cases also the most direct route between the two centres lies across Antarctica, and by cumulative evidence from plants and animals of many and varied kinds the conclusion is reached that this was the way they went.

Prof. Seward gave a brief account of some of the fossil plants collected by members of Captain Scott's second expedition, with special reference to Dr. Wilson's discovery of Glossopteris in 85° S. Fragments of well-preserved leaves of *Glossopteris indica* found in the rocks of Buckley Island, a nunatak on the Beardmore Glacier, afford important evidence, both as to the age of the Beacon Sandstone formation and as to a former connection between Antarctica and Gondwana Land. The geological distribution of Glossopteris in other parts of the world suggests that the strata of the Buckley nunatak must be assigned to the Permo-Carboniferous period. A large piece of wood obtained by Mr. Priestley from a sandstone boulder on the Priestley Glacier in 74° S. proved to be a gymnospermous stem of considerable botanical interest; the wood shows well-marked rings of growth and exhibits Araucarian characteristics, but in view of certain peculiar features has been referred to a new genus—Antarcticoxylon. Associated with this was found a winged pollen-grain, described as Pityosporites, which bears a striking resemblance to the pollen of recent Abietineæ. In conclusion, Prof. Seward referred to the bearing of these important discoveries on climatic considerations, and pointed out that while there is clear evidence of a considerable change in climatic conditions since the period when Glossopteris flourished on the Antarctic continent, there is no adequate reason to assume any change in the position of the earth's axis. Meagre as it is, the material collected by the polar party calls up a picture of an Antarctic land on which it is reasonable to believe were evolved the elements of a new flora that spread in diverging lines over a Palæozoic continent, the *disjuncta membra* of which have long been added to other land-masses where are preserved both the relics of the southern flora and of that which had its birth in the north.

Plankton.

Prof. Herdman gave an account of some recent plankton investigations in European seas (especially in the Irish Sea and off the west coast of Scotland), and of the apparatus used and the difficulties met with. He exhibited photographs of different samples of hauls showing that the diatoms attain their maximum in spring and are at a minimum in summer, while the copepods are few in spring but numerous in summer. He pointed out the necessity for taking samples simultaneously with vertical and horizontal nets, and for using coarse and fine nets in order to gain a true picture of the total plankton, and referred to the irregularity in distribution of plankton organisms, swarms of organisms being sometimes present in restricted areas, hence it was necessary to be careful in drawing conclusions from the samples taken in a single haul. He briefly discussed the application of plankton investigations to fishery problems, pointing out that diatoms are the ultimate food of marine animals, and therefore the starting-point of the problems.

The Abrolhos Islands.

Prof. W. J. Dakin gave a summary of some of the results of recent work by himself and Mr. W. B. Alexander on the Abrolhos Islands. These are situated in lat. 28° 40′ S., about fifty miles off the west coast of Australia, and near the edge of the continental shelf. The depth of water between the islands and the mainland averages about 25 fathoms, while a few miles west the depth is some hundreds of fathoms. The islands are composed entirely of coral, all the rock above sea-level (the highest point in any of the islands is 50 ft.) being uplifted coral rock or sand. There are distinct traces of a very recent uplift of about 8 ft., but at an earlier date—quite recent geologically—a much greater uplift put the islands in connection with the mainland. As a consequence of this former land connection certain of the islands are now inhabited by large numbers of wallabies, several species of amphibia, and many species of reptiles. There is thus a combination of the features of coral islands and the continental terrestrial fauna. There is evidence that a warm tropical current flows southwards and reaches the Abrolhos, and possibly accounts for certain tropical characters of the fauna of the islands. The neighbouring mainland is bathed by cooler waters, probably of southern origin. Prof. Dakin recorded from the islands a considerable number of interesting animals, including a new species of Ptychodera allied to *P. flava*.

The Development of Trypanosomes in the Invertebrate Host.

Prof. E. A. Minchin showed that if an analysis and comparison be made of those instances in which it can be claimed that the development of a given species of trypanosome in its invertebrate host is known, it is seen that in every such instance there is a part of the developmental cycle which is constant in occurrence and uniform in character, and another part which is of inconstant occurrence and variable in character.

In the constant part of the cycle the parasite always assumes the crithidial type of structure and multiplies incessantly in this form to produce a lasting stock of the parasite, certain individuals of which change sporadically from the crithidial into the trypaniform type and so become the final, propagative form of the development, destined to pass back into the vertebrate host and establish the infection in it. During hunger-periods the crithidial forms may pass temporarily, in some cases (*e.g.* the trypanosome of the skate in the leech Pontobdella), into the resting, non-flagellated leishmanial form, until food is again abundant, when they form a new flagellum and revert to the crithidial type of structure.

The inconstant part of the cycle, when it occurs, is intercalated at the very beginning of the development in the invertebrate, and lasts but a relatively short time; it is derived directly from the trypanosomes taken up by the invertebrate from the vertebrate host, and takes the form of an active multiplication of the parasites in either the trypaniform (*e.g.* *Trypanosoma gambiense* in the tsetse-fly) or leishmanial (*e.g.* *T. cruzi* in the bug Conorhinus) condition. In the cases where this early multiplicative phase is wanting altogether, the trypanosomes taken up by the invertebrate host pass at once into the crithidial phase (*e.g.* *T. vivax* in tsetse-fly).

When a further comparison is made between the development of trypanosomes in the invertebrate host and the development of the closely allied species of

Crithidia (*e.g. C. melophagia* in the sheep-ked) and Leptomonas, which have no alternation of hosts or generations, but are confined during their entire life-history to particular species of invertebrate hosts, it is seen at once that the life-cycles of these parasites of invertebrates are similar in all essential points to the crithidial phases of trypanosomes in their invertebrate hosts. It is evident, therefore, that the crithidial phase in the development of a trypanosome is to be interpreted as a reversion to, or recapitulation of, the type of development that occurred in the ancestral form which was originally a parasite of the invertebrate alone, before it had obtained a footing in the vertebrate host or had acquired the trypanosome-like type of structure; while the multiplicative phases of variable character preceding the crithidial phase in trypanosome-development are to be regarded as having been intercalated secondarily into the life-cycle and of no phylogenetic significance.

Australian Haematozoa.

Dr. J. Burton Cleland remarked that, owing to the geographical isolation of Australia, the study of the blood-parasites of the vertebrates, especially of such as have no easy means of passing over stretches of ocean, is of considerable interest. In some cases, *e.g.* the marsupials, speculation arises as to whether the hæmogregarines found in them reached Australia (1) with the marsupials when these originally came; (2) as parasites of the invertebrate host by a separate arrival; or (3) whether their appearance represented the adaptation in Australia of a parasite, at one time confined to an invertebrate host, to a habitat partly in a vertebrate and partly in an invertebrate host. Dr. Cleland considered the first of these suggestions to be the most reasonable. He directed attention to the records of the principal protozoon parasites of the blood of Australian vertebrates. Plasmodium seems to be rare in birds, while Halteridium is common. Trypanosomes have been found in several species of birds, and often in the same infected birds are large parasites, apparently the intracorpuscular form of the trypanosome.

Australian Trematodes and Cestodes.

Dr. S. J. Johnston passed in review the principal Australian Trematodes and Cestodes, and stated that the entozoan fauna of the host-animals belonging to any particular class of vertebrate might be separated into two divisions: (1) those which have been parasitic in these hosts for a very long time, practically from the first appearance of the host-animals; and (2) those which represent more recent acquirements. The members of the former division may be readily recognised by the fact that they have near relatives parasitic in other branches of the same stock, while members of the latter division generally have not. The members of each genus (or sometimes of several closely related genera) in the former division, in many cases scattered all over the world, constitute a natural group, and must be regarded as derived from common ancestors. These ancestors were parasites of the progenitors of the host-animals in the very early days when the group was much more restricted in its distribution than it is at the present time. A study of the relationships and distribution of the parasites affords some circumstantial evidence of the past movements and paths of dispersal of the host-animals. Dr. Johnston instanced the entozoan fauna of marsupials in Australia, which comprises a number of Cestodes (*e.g.* Linstowia) and Trematodes (*e.g.* Harmostomum), the nearest relatives of which are found in species of the same genera which live parasitic in South American marsupials.

Parasitic Worms of Queensland.

Dr. Wm. Nicoll stated that the hook-worms, Ankylostoma and Necator, are the most common human parasites in Queensland, but these worms are not more common there than in temperate regions. Hydatids are much rarer in Queensland than in other parts of Australia. Dr. Nicoll gave a brief general account of the more important parasites observed in animals in Queensland, and referred in particular to *Onchocerca gibsoni*, the round-worm which causes nodular disease in cattle. The life-history of this worm still remains unknown, but a considerable amount of experimental work has been carried out thereon. It has been suggested that infection is either direct (taking place in young animals) or by the agency of some biting insect. Dr. Breinl's experiments indicate the possibility of infection by means of water, for he was able to induce larvæ of Onchocerca to pass out through the unbroken skin, and to emerge into water where, however, they lived only a short time. Attempts to infect various aquatic animals with the larvæ were unsuccessful. Larvæ ingested by the stable-fly (Stomoxys) were able to live therein for several days, but Dr. Cleland could not detect any development in these larvæ. Dr. Nicoll applied sterile water on a calico pad, or in a glass vessel, to the skin of a cow over an Onchocerca nodule, but did not obtain larvæ. Experiments on excised nodules placed in water showed that the larvæ can, and do, make their escape through the capsule enveloping the worm-nodule, and therefore may be found close to the surface of the body in such positions that they can be readily ingested by a biting insect.

Studies on Echinoderm Larvae.

Dr. T. Mortensen gave an account of his recent work at Misaki (Japan), undertaken with the object of studying the inter-relationships between larval and adult forms of Echinoderms, and of testing the view that within the different families the larvæ have certain structural features in common, for if this prove to be a general rule larval characters may be of considerable importance in helping to settle doubtful cases in Echinoderm classification. Dr. Mortensen reared more or less completely sixteen species. Among these were three Temnopleurids, the larvæ of which have been hitherto unknown. This family has a special form of larva characterised by peculiarities of its skeleton. Four species of Clypeastroids—*Clypeaster japonicus*, Mellita sp., *Laganum fudsiyama*, and *L. decagonale*—were reared; their larvæ all proved to be of the type characteristic of other Clypeastroids. *L. fudsiyama* is a deep-water species (200–1000 mètres), and this is the first time that the larva of a deep-water Echinoderm has been reared. The larva is pelagic and of typical Clypeastroid structure. *L. decagonale* has large eggs, rich in yolk, and in correlation with this the development is shortened, the whole metamorphosis being completed in three to four days. The larva takes no food, the mouth being rudimentary; there is no ciliated band, but a strong general ciliation. The larval skeleton is rudimentary, but of the usual Clypeastroid form; only four larval processes at most are developed, but generally only two, sometimes one, three, or none. *Asterina pectinifera* was found to have a pelagic larva, while the two other species, the development of which is known, take care of the brood and have non-pelagic larvæ. The larva of this species has a Brachiolaria stage, thus proving the correctness of the view that the larval appendages in the young *A. gibbosa* are homologous with the brachiolarian processes of free-swimming larvæ.

Sheep-maggot Flies.

Mr. W. W. Froggatt exhibited specimens of four species of Diptera, the larvæ of which have been found on sheep in New South Wales. The common blow-fly (*Calliphora villosa*) is a serious pest to wool-growers, as it "blows" the soiled wool on the backs of living sheep, and the resulting maggots feed upon the wool-substances, and when full grown fall out and pupate on the ground. This fly will also "blow" meat or any kind of animal matter. Two other species of Calliphora (*oceaniae* and *rufifacies*) also attack sheep and all kinds of animal matter. The fourth fly—*Lucilia sericata*, the green-bottle fly—is the common sheep-maggot fly in Britain, but although found at times breeding in living wool in Australia, is not common in living wool, but is found about Sydney commonly living on all kinds of animal and vegetable matter, and congregating on plants and shrubs. Although it will "blow" meat placed outside, it seldom enters houses as do the common blow-flies. *C. rufifacies* had not been recognised as a sheep-fly as late as 1910, and had not up to that date been bred from the maggots found in soiled wool, though in the west of New South Wales the fly was plentiful about killing yards, freshly skinned sheep, and dead animals. This fly seems to have recently adopted the habit of "blowing" the wool owing to the presence of soiled and "smelly" wool, and in the north and west of the state this is now the common sheep-maggot fly, while the two other species do comparatively little damage in those areas. Mr. Froggatt also exhibited a Chalcid (*Nasonia brevicornis*) which was found to infest the larvæ and pupæ of *C. rufifacies*, and remarked that the discovery of this parasite was important and might possibly lead to new methods of control of the sheep-maggot flies.

The Emergence of the Nymph of ANAX PAPUENSIS.

Mr. R. J. Tillyard described the emergence of the nymph of this insect (order Odonata). During the three days previous to hatching, the beats of the dorsal vessel increase in number from about 30 to nearly 100 per minute, and just before hatching a cephalic heart appears in the posterior head region which drives blood forward into the head. The pressure thus caused forces off the cap of the egg and the nymph emerges quickly, swathed in an outer sheath (the "amniotic covering," Balfour Browne), which is found to be a non-cellular chitinous cuticle, not related in any way to the amnion, but representing the first moult of the larva. The swathed stage, which may be termed the pro-nymph, lasts only a few seconds. The cephalic heart increases enormously and consists of two large chambers which pulsate regularly and drive blood into the head. The latter quickly swells to twice its original size, and thus the pro-nymphal sheath is split dorsally and the young nymph emerges, freeing itself from the sheath by a few convulsive struggles. The cephalic heart quickly subsides in the free nymph. Meanwhile a rectal pulsating organ pumps water into the rectum, the branchial basket there being thus distended, and the whole tracheal system of the nymph becomes gradually filled with air. It is suggested that the rupture and atrophy of the amnion, described by Brandt in the embryology of Odonata, is due to the formation of the pro-nymphal sheath, which forms a close-fitting and far more efficient protection to the embryo.

Scent-distributing Apparatus in Lepidoptera.

Dr. F. A. Dixey pointed out that certain specialised scales found in various situations on the wings, bodies, and limbs of Lepidoptera are well known to be concerned in the distribution of a scent, which is in many cases characteristic of the species. These scales may occur in both sexes, but certain forms of them, *e.g.* the plume-scales of Pierines and Nymphalines, have been found only in males. The Pierine plume-scale often affords a ready means of identifying the species, and is frequently of service in throwing light on questions of affinity.

In some cases a special adaptation exists with the object of economising the scent until it is required for purposes of sexual recognition or attraction; for instance, the costal folds of the fore wing in many Hesperids, and the collection (seen in many Pierines and in some Satyrines and Nymphalines) of the scent-distributing scales into a patch, situated on that portion of the fore or hind wing which is covered in the position of rest.

Mimicry.

Prof. Poulton, after remarking that Australia is the most isolated of all the inhabited continental tracts, considered how far this is reflected in the insect-models and their mimics, and stated that although the subject had hitherto been little studied in Australian material, there were already conclusions of much interest.

Perhaps the most widely spread models in the world are the black, yellow-banded, stinging Hymenoptera. The central members of these powerful combinations are wasps (Diploptera), around which are ranged sand-wasps (Fossores), and, in far smaller numbers, bees (Anthophila), followed by mimetic species of the phytophagous Hymenoptera, and of other orders—Diptera, Coleoptera, Lepidoptera, etc. Throughout this dominant combination of models and mimics the sub-cylindrical body is black, encircled by many bright yellow bands; although widespread over the world, it is especially powerful in the north temperate zone. In Australia, however, its place is taken by a combination with a distinct pattern; the bands are deep-brownish orange (instead of yellow), and are few and broad (instead of many and narrow). This pattern runs through a large and complex set of models and mimics. Prof. Poulton remarked that it was very convincing to compare such a mimetic Asilid fly as the European *Asilus crabroniformis* with the Australian species, and to observe how their very different patterns resemble those of the respective Aculeate models, and that an equally significant comparison may be drawn between the mimetic Longicorn beetles of these two parts of the world.

A question as to whether insects in different geographical areas resembled each other in colour and pattern was answered by Dr. Dixey, who stated that such cases did occur, but were very exceptional, and should, in his opinion, be regarded as mere coincidences. There were no such coincidences known where complex patterns were involved, but when a simple pattern is concerned it may occur more commonly in widely different parts of the world.

Experiments on Silkworms.

Prof. Otto Maas gave an account of his experiments on the feeding of silkworms on different foods, *e.g.* mulberry and Scorzonera. When both parents were fed on Scorzonera the capacity of fertilisation is much inferior to normal, the number of eggs deposited is much fewer, and of the eggs fertilised fewer hatch. In the case where only one parent is fed on Scorzonera the mating may be as fertile as a normal one. A cross between a Scorzonera-fed and a mulberry-fed strain seemed to be superior in strength to one fed only on mulberry.

Species of Victorian Lampreys.

Dr. J. A. Leach stated that examination of 46 lampreys in the National Museum and the University Museum, Melbourne, showed a remarkable amount of

variation in almost every character used by systematists to distinguish different species. In six specimens of *Geotria chilensis* taken alive at the same time, the length of the interspace between the two dorsal fins varied from 0·6 of the length of the dorsal fin to 1·3 times that length. Dr. Leach divides the 24 specimens of Geotria examined into three species, and the 22 specimens of Mordacia into two species. The remarkable, large pouch of *Geotria australis* is not a secondary sexual character, for it is present in females as well as in males; its use is not known.

Notes on Australian Frogs.

Mr. J. Booth commenced work on the Australian frogs in the hope of finding some method of identification without resort to the dissection necessary to examine the sternal apparatus and the sacral vertebræ, but found that description and measurement of the external features could not replace observations on the skeletal girdles, the characters of which are of paramount significance, while the external configuration is more related to the mode of life of the animals and largely corresponds with the classification into swimming, climbing, burrowing frogs. The frogs found in Australia belong almost entirely to the three families of the Arcifera—Cystignathidæ, Hylidæ, and Bufonidæ. To these must be added the family Ranidæ (of the Firmisternia) on account of the occurrence of *Rana papua* in New Guinea, and on account of the recent record of three species of the genus Austrochaperina. Mr. Booth remarked on certain varieties of interest and on the occurrence of abnormal examples, the significance of which was suggested.

Migration of Birds.

Prof. C. J. Patten referred to some features in the diurnal migration of pipits, wagtails, and swallows as observed at Tuskar Rock Light-station (Co. Wexford). In certain periods of spring and autumn a procession of migrants passes this station daily, but owing to the barren nature of the rock comparatively few birds alight. Most birds fly towards the land, even those presumably on emigration. Pipits and wagtails were estimated to travel at about 20 miles per hour, swallows and martins at about 90 miles per hour. On account of the very limited area of the rock, and the considerable altitude at which many of the birds fly, the descending flight for the purpose of alighting, when attempted, is almost perpendicular.

Photographs of Narwhal and Beluga.

Prof. H. F. E. Jungersen exhibited photographs taken at Umanak in Western Greenland by a Danish physician. The first series was of full-grown male narwhals, and showed clearly that the tusk pierces the skin of the left side of the snout above and outside the mouth-opening. Prof. Jungersen remarked that neither text-books nor original descriptions by authors who have examined the narwhal in the flesh give clear statements of the exact relation of the tusk. There is, however, one exception: J. Anderson (1746) states definitely that in a narwhal captured in the Elbe the tusk pierces the left upper lip. The photographs of the Beluga prove that the front end of the snout, under the rounded forehead, forms a short but distinct beak. Most descriptions deny the existence of a "beak," or do not mention it, but in some of the better figures (*e.g.* by Scoresby and Flower) a "beak" is clearly shown.

The Sizes of the Red Blood Cells of Some Vertebrates.

Dr. J. Burton Cleland summarised a series of systematic measurements of the red blood corpuscles of various Australian vertebrates, and stated that the figures seem to indicate that with specialisation has come eventually, both in fishes and birds, a diminution in size of the red cells. The relationships of the various classes of animals to each other is clearly shown in the size of the red cells; those of Elasmobranchs approximate more nearly in size to those of Batrachians and Reptiles than do the red cells of Teleostean fishes. The enormous red cells of the Dipnoi, those of Ceratodus being $39 \times 25\,\mu$, approach those of the Urodela (the red cells of Proteus are said to be $58 \times 35\,\mu$, and those of Amphiuma $77 \times 46\,\mu$). In the frogs and reptiles the size of the red cells has decreased, and in birds the "oldest" forms show distinctly a tendency to larger cells than the more specialised ones, the smallest red cells (10 to 12×5 to $7\,\mu$) being met with in some families of Passerine birds, while the largest ($16 \times 9\,\mu$) are found in the emu.

The Heredity of Some Emotional Traits.

Prof. C. B. Davenport observed that while sociologists, who place great stress on the importance of conditions in determining human traits, have been forced to admit the hereditary basis of feeblemindedness, they still hold, for the most part, to the view that in the moral field heredity plays little part. To test this view, inquiry was undertaken into the inheritance of traits of persons of the criminalistic type, the base of the study being the family history of 165 wayward girls in State institutions of the United States. About 20 traits were considered in some detail; many did not yield any clear-cut results, but in a least five the hereditary factor was clear, and evidently determined the behaviour. (1) The tendency to tantrums or violent outbursts of temper is inherited in adults as a dominent trait, *i.e.*, does not skip generations. In several instances it was possible to trace back the tendency three, four, and even five generations. (2) Violent eroticism was similarly traced back; half of the offspring of a highly erotic parent show similar impulses. (3) Impulsions to suicide are accompanied by depressions, and it appears that this depression is inherited as a recessive or negative character. It ordinarily skips generations, but the tendency is generally found on both sides of the parentage of the affected individual. (4, 5) Two other traits—dipsomania and nomadism—appear to be sex-linked characters transmitted through mothers to some or all of their sons. They appear in daughters typically only when shown by the father and when the tendency is also carried by the mother. If both parents show the trait, all the children have the tendency to develop the trait in due time.

The Hormone Theory of Heredity.

Dr. J. T. Cunningham held that Mendelism throws no direct light on the origin of characters; it deals merely with their transmission. It is inferred, however, by Mendelians that characters transmitted as units arose as units. From the evidence of Mendelian researches it is reasonable to conclude that non-adaptive specific and other diagnostic characters arose in the course of gametogenesis and conjugation, but the doctrine of Mendelism or mutation was, in Dr. Cunningham's opinion, not applicable to the phenomena of adaptation. He cited in support (1) Animals such as the frog, flat-fish, and caterpillar, which exhibit adaptation to two quite different sets of conditions in the individual life, and he held that it was impossible to believe that such transformation was due to mutations not caused by the external conditions, for there is no evidence that the necessary gradual changes could occur unless the conditions produced them. (2) The phenomena of secondary sexual characters, of which one of the most impressive and fully

investigated is that of the antlers of the stag. The Mendelians regard such characters merely as mutations which are coupled with primary sex; but primary sex is determined at fertilisation, and such secondary characters have been shown to be dependent on the presence and function of the gonads. Characters which are determined in the gametes are not generally affected by amputations of the gonads or any part of the body in after life. It has been shown that the effects of castration on the development of secondary sexual characters are due to the stimulus of chemical substances produced by the gonads, especially in their functional activity.

The hormone theory explains how somatic modifications may be transmitted to the gametes, the hypertrophied tissue giving off chemical substances or hormones which stimulate the determinants in the gametes. A special application of this principle is necessary in the case of the functional secondary sexual characters to explain how it is that their development is so closely dependent on the functional activity of the gonads. This special part of the theory assumes that the original modification was produced in the presence of the hormone from the sexual organs, and consequently the inherited modification cannot develop in the soma except in the presence of this hormone.

The following communications were also made to the section, but in the absence of the specimens and diagrams used in illustration they do not lend themselves to the purposes of a summary.—Prof. Poulton gave an account of Dr. Perkins's researches on the colour-groups of Hawaiian wasps, Prof. Jungersen described the anatomy of Pegasus, which he showed to be an Acanthoptervgian, and to require at least a suborder of its own, for it is distinguished by several structural peculiarities from all known fishes; Mr. T. Steel exhibited beautifully preserved examples of several species of Peripatus and of Australian land planarians, and added observations on their special features and habits; and Mr. E. de Hamel gave a general account of the ringing of birds and some of the observed results. J. H. ASHWORTH.

THE SUPPLY OF CHEMICALS TO BRITAIN AND HER DEPENDENCIES.[1]

AFTER showing that the foundations of theoretical chemistry were laid almost exclusively by the chemists of England, France, and Sweden, the speaker proceeded to discuss the position of industrial chemistry. The "Report on Chemical and Pharmaceutical Products and Processes" in the International Exhibition of 1862, from the pen of A. W. Hofmann, then professor of chemistry in the Royal College of Chemistry and Royal School of Mines, London, contains the following passage (p. 3):—"The contributions of the United Kingdom, and in particular the splendid chemical display in the Eastern Annexe, prove the British not only to have maintained their pre-eminence among the chemical manufacturers of the world, but to have outdone their own admitted superiority on the corresponding occasion of 1851."

Statistics in relation to the development of the alkali trade show how rapidly the production of what are called "heavy chemicals" was proceeding at this period. Figures derived from returns collected by Mr. Christian Allhusen from 81 per cent. of the manufacturers in the United Kingdom, immediately after the first Great Exhibition, are shown below. These may be compared with statistics prepared by Mr. W. Gossage for the year 1861 immediately before the exhibition of 1862[2]:—

	1852 Tons	1851 Tons
Soda ash	71,193 ...	156,000
Soda crystals	61,044 ...	104,000
Bicarbonate	5,762 ...	13,000
Bleaching powder ...	13,100 ...	20,000

The value of these products for 1852 was estimated at about 1¾ million pounds, while the value of the products of 1861 was calculated by Mr. Gossage at upwards of two millions sterling.

The Board of Trade has recently issued a bulletin concerning German competition in the United Kingdom market, and on p. 2 we find the statement that the soda compounds, excluding chromates and bleaching powder, produced in the United Kingdom in the year 1907, are valued at 3,390,000*l*. The imports from Germany in 1912 are valued at only 8700*l*. As to bleaching materials, the product of the United Kingdom for 1907 is estimated at 527,000*l*., while the import from Germany for 1912 was 44,600*l*.

From these figures the easy deduction is made that "the imports of these chemicals into the United Kingdom from Germany are relatively insignificant when compared with the output of the same articles in this country. It is clear that in these particular lines British manufacturers have no need to fear German competition in the home market."

Similar remarks apply to aluminous compounds, coal-tar products not dyes, the cyanides, sulphuric acid, and other acids for which the bulletin may be consulted. It thus appears that the British manufacturers of sulphuric acid and soda, from the early times of a century ago, have been able, up to the present, to hold their own against foreign competition, and have thus added substantially to the revenues and well-being of their country.

Now leaving to the department of "heavy chemicals" all such things as agricultural and horticultural washes, coarse disinfectants, and artificial manures, the question arises, How do we in England stand in regard to the supply of drugs, dyes, photographic chemicals, agents for research, and perfumes at a time when many of these things are very urgently needed?

It may be safely asserted that the sources of supply of all these materials in the United Kingdom are seriously inadequate. And, further, we may point to the acknowledged fact that many of the dyes, nearly all the synthetic drugs, and photographic materials have been systematically imported from Germany.

The annual statement of the Board of Trade (p. 108) shows that in 1913 we imported from Germany:—

	£
Alizarin and anthracene dyes ...	271,119
Aniline and naphthalene dyes ...	1,382,478
Synthetic indigo	76,681
	£1,730,278

Under the head of "Drugs, unenumerated, including Medicinal Preparations" (p. 107), out of a total of imports from foreign countries and from British possessions amounting to 1,302,860*l*., more than one-fourth, or to the value of 332,464*l*., was in 1913 received from Germany. From this is to be deducted the inconsiderable amount of dyes and other chemicals from coal-tar, valued at 24,691*l*., exported in 1913 to Germany (p. 300). According to the Final Report on the First Census of Production of the United Kingdom for 1907 (p. 547), this country made 139,000 cwt. of coal-tar dyes, valued at 373,000*l*., of which practically the whole was consumed at home.

[1] Abstract of a paper read before the Royal Society of Arts on November 25 by Sir William A. Tilden, F.R.S.

[2] Gossage's "History of the Soda Manufacture."

As to fine chemicals for analysis and for research, there are no figures available, but it may safely be said that there has been no appreciable production of these things in this country.

If we are ever to be in a position to supply ourselves and our Dependencies with the dyes, the drugs, and the rest of the fine chemicals required in our works, it will only be achieved after a careful review of the circumstances which led to the removal of the industries from this the country in which many of them originated, together with a determination to take to heart the lessons of the past.

After a review of these circumstances in which it is shown that it has not been due to inactivity on the part of scientific chemists, but to the ignorance and neglect of British manufacturers down to quite recent times, the author considered what ought to be done and what it is possible to do in this country to remove reproach from British chemical industry, and to render the Empire independent of supplies from foreign sources.

We need many first-rate chemists, a few engineers, plenty of capital, and some good men of business. A combination of these elements in due proportion is certain of success, and the time, though so unhappy for the world, is favourable for this enterprise.

Inasmuch as the functions of each and the best way of combining them have already been settled in practice on the Continent, is to be hoped that the ancient precept about being taught by the enemy—*fas est et ab hoste doceri*—will not be forgotten. For there can be no doubt that the principle acted on in all German chemical factories, namely, the employment of the best available scientific skill and the constant appeal to scientific research, has been the secret of their success.

In conclusion, two remarks only require to be made. The establishment of what will be practically a new industry in this country will require consideration and assistance from the State, if it is to survive the period of fierce competition which will follow the conclusion of the war. Encouragement is already promised to the dye industry, in the form of definite financial aid to be given by Government. But remembering that the colour-maker is dependent on the production of many chemicals, which represent intermediate stages in the processes which lead from the raw materials to the finished product, and that the production of these chemicals is naturally associated with other chemical manufactures, it is to be hoped that the temporary protection will be extended beyond the immediate field of the colour-maker.

The other remark may raise a smile on the part of those business men who are moved only by commercial considerations. There will be a great temptation when the war is over to resume former business relations with the enemy. The German chemical manufacturers have a powerful organisation and many years of experience behind them. Let them keep any markets they can retain outside the British Empire, but every man who cares for his country will surely demand that business at home shall be limited to British goods.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

EDINBURGH.—The chair of medicine and clinical medicine in the University has become vacant through the retirement of Prof. John Wyllie. With the exception of the years 1866 to 1868, when he was house physician to the General Hospital in Birmingham, Prof. Wyllie has lived his professional life in Edinburgh, where he filled many important positions as a physician, and attained a high reputation in medical circles. In addition to contributions to medical journals, he is known as the author of a book on "The Disorders of Speech," published in 1894.

As in all other universities the war has seriously depleted the classes in Edinburgh. The diminution is observable in all the faculties, but is particularly noticeable in the later years of the medical curriculum, in the third year of engineering science, and in the law classes. A considerable number of the junior staff of lecturers are also with the colours. To encourage students to offer themselves for service the University authorities have granted important privileges, so that when the war is over the studies may be resumed without serious loss of time. The great majority of the men who are attending classes are being drilled several times a week, and are receiving military instruction. The Indian students are being trained as an ambulance corps.

LONDON.—A course of nine advanced lectures on certain aspects of British ecology will be given at University College, with the exception of lecture 5, which will be given at the Botany Building, Imperial College of Science, Prince Consort Road, South Kensington, S.W., at 5 p.m. on the following dates:—December 10, Dr. E. J. Salisbury, "Woodlands"; December 17, Dr. W. G. Smith, "Grasslands"; January 14, Dr. C. E. Moss, "Unsolved Problems relating to Calcareous Vegetation"; January 21, Miss M. C. Rayner, "Some Aspects of Heath Vegetation"; January 28, Prof. J. B. Farmer, "Alpines"; February 4, Dr. E. J. Salisbury, "Determining Factors in Aquatic Distribution"; February 12, Prof. R. H. Yapp, "Fen Vegetation"; February 18, Prof. G. S. West, "The Occurrence and Distribution of Fresh-water Algæ"; February 25, Mr. A. D. Cotton, "The Algal Vegetation of the Salt-marsh and Seashore." The lectures are addressed to students of the University and to others interested in the subject. Admission is free, without ticket.

SHEFFIELD.—Dr. W. MacAdam has been appointed to the post of demonstrator in public health, and Mr. T. Chetwood to the post of lecturer on hygiene in the training department.

MR. G. S. YUILL, of Yuills, Ltd., a graduate of Aberdeen University, has made a gift of 4000*l.* to the University, the interest upon this amount to be applied in furthering the study of chemistry.

IT is announced in *Science* that the United States General Education Board has granted 50,000*l.* to Goucher College, Baltimore, conditionally upon 150,000*l.* being raised by April 1, 1917. From the same source we learn that a fund of 12,000*l.* has been turned over to Amherst College by the alumni council. The disposal of the income from this sum is to be determined by the trustees and the council.

WE learn from *Science* that on November 19 the honorary degree of doctor of science was conferred by Brown University upon Prof. W. H. Bragg, of the University of Leeds, before the corporation and faculty of the University in special Convocation. Following the conferring of the degree Prof. Bragg delivered the last of four lectures on X-rays and crystals, which he has been giving as the first of the anniversary lectures to celebrate the one hundred and fiftieth anniversary of Brown University.

NOTICE is given by the Institution of Naval Architects that a scholarship, to be known as the "Institution of Naval Architects Scholarship in Naval Architecture," will be offered for competition among students of the institution in 1915. The scholarship, which is of the annual value of 100*l.*, and tenable for

three years, will be awarded in connection with the competitive examinations for scholarships, studentships, etc., to be held by the Board of Education in May, 1915, in naval architecture, pure mathematics, applied mechanics (materials and structures), and either applied mechanics (machines and hydraulics), or heat engines. Applications must reach the secretary of the Institution of Naval Architects on or before January 15.

AT the last meeting of the governors of the South-Eastern Agricultural College, Wye, the principal, Mr. M. J. R. Dunstan, reported that 110 students and thirteen members of the teaching staff, besides college servants, farm and garden employees, had joined the colours. The new college buildings have been completed at a cost of 12,500*l.*, towards which the Board of Agriculture has given 6000*l.*, whilst two grants, each of 500*l.*, have been made by a generous anonymous benefactor towards the completion of the research equipment, and these gifts have been met by equivalent grants from the Board of Agriculture. The probable financial position of the college, owing to the reduction in the number of students, was considered, and it was decided to bring the matter before the Government educational and agricultural departments before taking any definite steps to curtail the teaching or research work. A vacuum drying plant for experimenting on the drying of fruit and vegetables has been installed by means of a grant from the Board of Agriculture, and it is hoped that assistance may be forthcoming to continue the investigations into the economical feeding of dairy cows of which a third report has just been issued. Results which may prove to be of considerable practical value have been obtained from the hop-breeding experimental work.

THE report of the Commissioner of Education of the United States Bureau of Education for the year ended on June 30, 1913, has been received from Washington. It consists of two bulky volumes running to 931 and 700 pages respectively, and every department of American education is dealt with exhaustively. For the academic year with which the report deals, the bureau received reports from 596 universities, colleges, and technological schools in the United States. Ninety-four of these institutions are controlled by States or municipalities, and 502 are administered by private corporations. The number of collegiate and resident graduate students in these institutions of higher education was during the year 128,644 men and 73,587 women, as compared with 125,750 and 72,703 in the preceding year. These numbers show on analysis an increased attendance of 2·35 per cent. of college students in graduate and undergraduate courses, and a decrease of 11 per cent. in the number of preparatory students. The Commissioner points out in his introduction that in most instances high-school work can be done better and at less cost in the regular high schools than in the preparatory classes of colleges. The decrease in the number of students in the preparatory classes of colleges is due to some extent also to the more liberal practice of the colleges in accepting for admission work in subjects other than those heretofore required.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 3.—Sir William Crookes, president, in the chair.—M. de **Lange**: The thermophone—a new form of telephone.—Dr. G. S. **Walpole**: Hermann's phenomenon. At the boundary between two solutions of unequal specific conductivity a change of reaction is developed if a difference of potential be maintained between them. Alkali is liberated if the current passes from the better conducting solution to that not conducting so well; acid, if the current passes in the opposite direction. The amounts may be calculated from the potential gradients in the solutions on each side of the boundary, the time for which the difference of potential is maintained, the resistance constaht of the vessel employed, the dissociation constant of water, and the known migration velocities of hydrogen and hydroxyl ions.

Zoological Society, November 24.—Prof. E. A. Minchin, vice-president, in the chair.—D. M. S. **Watson**: (1) Description of a new reptile from the Permian of the Cape Province, South Africa. Mr. Watson regards this as derived from a Cotylosaurian ancestor and as perhaps related to Araeoscelis and the modern lizards. A new genus is founded for the reception of the so-called *Proterosaurus huxleyi*. (2) The origin of the Chelonia. A number of reasons is given for supposing that they may be descended from some such form as *Eunotosaurus africanus*, Seeley. (3) The skulls of Bauria, Microgomphodon, and Sesamodon. The relation of the group with the Cynognathids is discussed, and a new skull of Lycosuchus, in which both the prevomers and vomer are present, is described.—F. A. **Potts**: Polychæta from the N.E. Pacific: the Chætopteridæ. With an account of the phenomenon of asexual reproduction in Phyllochætopterus and the description of two new species of Chætopteridæ from the Atlantic. The new species of Phyllochætopterus was found in branched tubes, each usually containing several individuals. The origin of these colonies each from a single individual is suggested by the frequent occurrence of worms in various stages of regeneration. An examination of these shows that autotomy first occurs in the middle region of the animal's body, and a complete animal is regenerated from each of the two parts. This phenomenon appears to be characteristic also of another new species of this genus from Plymouth, which lives in small colonies in branched tubes. Several points in the morphology of the Chætopteridæ are also discussed.—E. **Heron-Allen** and A. **Earland**: Evidence of purpose and intelligence on the part of Foraminifera.

EDINBURGH.

Royal Society, November 16.—Prof. F. O. Bower, vice-president, in the chair.—Dr. D. **Ellis**: Fossil micro-organisms from the Jurassic and Cretaceous rocks of Great Britain. The paper contained a study of fossil moulds from four localities—the Frodingham Ironstone of Lincolnshire, the Secondary rocks in the Island of Raasay (N.W. Scotland), the Dunliath ferruginous Limestone, and the Gault, near Folkestone. These supplied in order a fossil mould belonging to the Phycomycetæ, with abundant examples of hyphæ, sporangia, and spores; a fossil mould provisionally named Palæomyces α; a fossil Actinomyces; and three members of Bacteria, two Bacilli, and one Micrococcus. Evidence was given that these were genuine micro-organisms, and reasons were discussed why the organism in its lifetime had a chemiotactic affinity for iron.—J. M'Lean **Thompson**: The anatomy and affinity of *Deparia moorei*. The paper dealt with the anatomical features of the axis, leaf, and sorus. Comparison with *Deparia prolifera* showed an advanced type of leaf trace, the expansive lamina being possessed of a few pinnæ and a reticulate venation—suggesting an adaptation for life in moist shade. The sori were of normally marginal origin, but occasionally truly superficial sori appeared on the upper leaf surface in *D. moorei*. This in no way invalided the conclusion that it belonged to the series Marginales. The consensus of characters justified the rejection of

an alliance with Athyrium or Aspidium, but rather assigned the plant to a place in the Davallioid series of forms.—Dr. T. **Muir**: Properties of the determinant of an orthogonal substitution.

PARIS.

Academy of Sciences, November 23.—M. Ed. Perrier in the chair.—A. **Chauveau**: Physiological weakness and tuberculosis in armies in the field. The debility caused by exposure to the hardships of a campaign in no way favours the introduction of the tubercle bacillus into the body. But, once the body is attacked by the organism, the reduced power of resistance to the ravages of the bacillus caused by privation and insanitary conditions may have a marked effect on the rapidity of development of the disease.—E. L. **Bouvier**: The carcinological fauna of Maurice Island. A description of some specimens collected by M. Carié during the last four years.—Haton de la **Goupillière**: A property of arithmetical progressions.—M. **Gonnessiat**: Observation of the transit of Mercury across the sun, November 6–7, at the Algiers Observatory. The transit was observed under excellent atmospheric conditions. The times of the four contacts are given and compared with the calculated data.—Henri **Chrétien**: The transit of Mercury across the sun of November 7, 1914. Details of observations made at Nice.—Comas **Solá**: Photographic observations of a small planet, apparently new. The photographs were obtained on November 15 at the Fabra Observatory, Barcelona.—C. Le **Morvan**: Photographic positions of comet 1913*f* (Delavan) obtained with the photographic equatorial at the Paris Observatory. Positions are given for September 5 and 6, October 7, 8, and 9.—Charles **Rabut**: The La Balme bridge.—André **Kling** and H. **Copaux**: The preserved meat of the Paris camp. A reply to a recent criticism of M. Balland.—Marcel **Rostaing**: A type of military under-garment.

NEW SOUTH WALES.

Linnean Society, September 30.—Mr. W. S. Dun, president, in the chair.—Dr. C. **Hall**: The evolution of the Eucalypts in relation to the cotyledons and seedlings. In regard to the form of the embryo in the Eucalypts, the cotyledons in the *E. corymbosa* group closely resemble those of Angophora, and are entire and reniform. With reference to the cotyledon-leaves of Eucalyptus, these may be divided into two great classes, entire and emarginate; and each of these into groups, according to size and shape. A study of the cotyledons supports the view that the *E. corymbosa* group is the most primitive type, while the Stringybarks have cotyledons of similar form. In response to the xerophytic conditions of Australia, the Eucalpyts have reduced the size of their cotyledons—first, by a general reduction in size, while retaining the entire, reniform shape; secondly, by the introduction of emargination, which, at last, becomes so extreme that Y-shaped cotyledons come to prevail in many of the dry-country species. The first pairs of leaves tend rapidly to assume the typical form of the juvenile foliage of the species, except in the Corymbosas, where, for a few pairs, the peltate form is adopted. Seedlings of about 150 species are figured.—Dr. R. **Greig-Smith**: Note on the bacteriotoxic action of water. When *B. prodigiosus* is used as a test-bacterium, and seeded into filtered tap-water, it generally increases. In boiled water, the rate of multiplication is lessened. Under the same conditions, *B. typhi* always decreases, and, in boiled water, the diminution is increased to such an extent that from three to six cells, out of 1000 added, remain after twenty hours.—Dr. R. **Greig-Smith**: Note on the destruction of paraffin by *B. prodigiosus* and soil-organisms. When *B. prodigiosus* is grown in the presence of paraffin, it attacks the hydrocarbon. Losses varying from 5 per cent. to 14 per cent. were obtained. Mixed soil-organisms, under the same conditions, destroyed from 11 per cent. to 49 per cent.

CAPE TOWN.

Royal Society of South Africa, October 21.—Dr. L. Péringuey, president, in the chair.—J. B. **Pole-Evans**: Some new South African aloes. The paper describes six new aloes from the Transvaal.—Th. **Wassenaar**: Optical illusions.—E. J. **Goddard** and C. S. **Grobbelaar**: A new genus of fresh-water Oligochætes (of uncertain position).—J. S. v. d. **Lingen**: The space-lattice of liquid crystals. The theory of the identity of molecules which cause the different forms of crystals of the same substance was discussed briefly. Experiments on the magnetic nature of certain liquid crystals were then described. The principal axis of the molecules lies parallel to the lines of magnetic force when the molecules are not influenced by other forces. As regards the optical properties of liquid crystals, the pseudo-isotropic layers behave like uniaxial crystals cut perpendicular to the axis. Vorlaender's experiments on such layers in convergent light show the well-known rings and crosses of uniaxial crystals. He believes that the pseudo-isotropic layers have space-lattices. When Röntgen rays are passed through such layers no interference phenomenon is obtained, hence there is no space-lattice. This indicates that: (1) the molecule itself is a small crystal possessing magnetic axes; (2) a change in the structure of the molecule itself causes a change in the form of the crystals of the same substance.

BOOKS RECEIVED.

Transactions and Proceedings of the Botanical Society of Edinburgh. Vol. xxvi. Pt. 3. Session 1913–14. Pp. xxxiii+299. (Edinburgh: Botanical Society.)

Canada. Department of Mines. Mines Branch. Magnetite Occurrences near Calabogie, Renfrew County, Ontario. By E. Lindeman. Pp. 16. Moose Mountain Iron-Bearing District, Ontario. By E. Lindeman. Pp. 14+8 maps. (Ottawa: Government Printing Bureau.)

Fighting in Flanders. By E. A. Powell. Pp. xix+227. (London: W. Heinemann.) 3*s.* 6*d.* net.

Boilers, Economisers, and Superheaters: their Heating Power and Efficiency. By Prof. R. H. Smith. Pp. viii+128. (London: Crosby Lockwood and Son.) 7*s.* 6*d.* net.

The City of Dancing Dervishes and other Sketches of Studies from the Near East. By H. C. Lukach. Pp. xi+257. (London: Macmillan and Co., Ltd.) 7*s.* 6*d.* net.

Through the Grand Canyon from Wyoming to Mexico. By E. L. Kolb. Pp. xix+344. (London: Macmillan and Co., Ltd.) 8*s.* 6*d.* net.

Text-Book of Embryology. Edited by W. Heape. Vol. i., Invertebrata. By Prof. E. W. MacBride. Pp. xxxii+692. (London: Macmillan and Co., Ltd.) 25*s.* net.

The Excavations at Babylon. By R. Koldewey. Translated by A. S. Johns. Pp. xix+335. (London: Macmillan and Co., Ltd.) 21*s.* net.

Macmillan's Geographical Exercise Books. II.—Europe. With Questions. By B. C. Wallis. Pp. 48. (London: Macmillan and Co., Ltd.) 6*d.*

Bricks and Artificial Stones of Non-Plastic Materials: their Manufacture and Uses. By A. B. Searle. Pp. vi+149. (London: J. and A. Churchill.) 8*s.* 6*d.* net.

William James and Henri Bergson, by Dr. H. M. Kallen. Pp. xi+248. (Chicago, Ill.: University of Chicago Press; London: Cambridge University Press.) 6s. net.

Water Reptiles of the Past and Present. By Prof. S. W. Williston. Pp. vii+251. (Chicago, Ill.: University of Chicago Press; London: Cambridge University Press.) 12s. net.

Institute of Chemistry of Great Britain and Ireland. Proceedings. Part iv. Pp. 32. (London: Institute of Chemistry.) 1s. net.

The Teaching of Mathematics in Australia. By Prof. H. S. Carslaw. Pp. 79. (Sydney: Angus and Robertson; London: Oxford University Press.) 2s. 6d. net.

An Introduction to the Geology of New South Wales. By C. A. Süssmilch. Second edition. Pp. xviii+269. (Sydney: Angus and Robertson; London: Oxford University Press.) 7s. 6d. net.

The Butterflies of Australia: a Monograph of the Australian Rhopalocera. By G. A. Waterhouse and G. Lyell. Pp. vi+239+plates. (Sydney: Angus and Robertson; London: Oxford University Press.) 42s. net.

The Year-Book of the Scientific and Learned Societies of Great Britain and Ireland. Thirty-first Annual Issue. Pp. vi+376. (London: C. Griffin and Co., Ltd.) 7s. 6d. net.

What is Adaptation? By Dr. R. E. Lloyd. Pp. xi+110. (London: Longmans and Co.) 2s. 6d. net.

Through the Brazilian Wilderness. By T. Roosevelt. Pp. xiv+374. (London: John Murray.) 18s. net.

The Journal of the Natural History Society of Siam. Vol. i., No. 2. (London: Luzac and Co.) 6s.

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 10.

ROYAL SOCIETY, at 4.30.—The Measurement of Arterial Pressure in Man. I.: The Auditory Method. II.: A Schematic Investigation: M. Flack, Prof. L. Hill and J. McQueen.—The Electrical Conductivity of Echinoderm Eggs, and its Bearing on the Problems of Fertilisation and Artificial Parthenogenesis: J. Gray.—The Endemic Flora of Ceylon with Reference to Geographical Distribution and Evolution in General: Dr. J. C. Willis.

MATHEMATICAL SOCIETY, at 5.30.—Simultaneous Equations, Linear or Functional: E. H. Neville.—Integrals and Derivatives, with respect to a Function: W. H. Young.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Automatic Protective Switchgear for Alternating Current Systems: E. B. Wedmore.

FRIDAY, DECEMBER 11.

ROYAL ASTRONOMICAL SOCIETY, at 5.—The Temperature Coefficients of the Edinburgh Transit Circle: R. A. Sampson and E. H. Baker.—Observations of the Transit of Mercury, 1914, November 6-7, made at the University Observatory, Warsaw: S. Tscherny.—The Transit of Mercury, 1914, November 6-7: Rev. A. L. Cortie.—Micrometrical Measures of 110 Wide Double Stars: W. S. Franks.—The Nebula Hv. 20 Ceti: Mrs. Isaac Roberts.—*Probable Paper*: Prof. Turner's Theory of a Sun-spot Swarm of Meteors Associated with the Leonids: R. A. Sampson.

MALACOLOGICAL SOCIETY, at 8.—The Geographical Distribution of *Purpura lapillus* (L.): Rev. A. H. Cooke.—The Non-Marine Mollusca of a Post-Pliocene Deposit at Apethorpe, Northants: A. S. Kennard and B. B. Woodward.—Monstrosities of Cypræa: L. St. G. Byne.—Monstrosities in *Littorina rudis*: J. E. Cooper.

JUNIOR INSTITUTION OF ENGINEERS, at 8.—Circulation of Boilers: L. Le Soeur.

MONDAY, DECEMBER 14.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Frontier Work on the Bolivia-Brazil Boundary: Capt. H. A. Edwards.

ROYAL SOCIETY OF ARTS, at 8.—The History and Practice of the Art of Printing: R. A. Peddie.

ARISTOTELIAN SOCIETY, at 8.—Symposium: Instinct and Emotion: W. McDougall, A. F. Shand, and Prof. G. F. Stout.

SOCIETY OF ENGINEERS, at 7.30.—Annual General Meeting.

VICTORIA INSTITUTE, at 4.30.—The Principles of World Empire: E. W. Maunder.

JUNIOR INSTITUTION OF ENGINEERS, at 8.—Presidential Address: The War and Engineering: The Marquis of Graham.

TUESDAY, DECEMBER 15.

ROYAL STATISTICAL SOCIETY, at 5.—A Further Note on the Fertility of Marriage in Scotland. Errors of Statement as to the Duration of Marriage: Dr. J. C. Dunlop.—Notes on the Census of Occupations: D. C. Jones.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further Discussion*: Tests of Reinforced Concrete Structures on the Great Central Railway: J. B. Ball.—Corrosion of Steel Wharves at Kowloon: S. H. Ellis.—Concreting in Freezing Weather and the Effect of Frost upon Concrete: J. Hammersley-Heenan.

WEDNESDAY, DECEMBER 16.

ROYAL SOCIETY OF ARTS, at 8.—Testing Pigments for Permanence of Colour: Sir William de Wiveslie Abney.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Distribution of Relative Humidity in England and Wales: W. F. Stacey.—Observations of the Upper Atmosphere at Aberdeen by Means of Pilot Balloons: A. E. M. Geddes.

ROYAL MICROSCOPICAL SOCIETY, at 8.—X-Rays in Relation to Microscopy: J. E. Barnard.

GEOLOGICAL SOCIETY, at 8.—The Palæolithic Age and its Climate in Egypt: Prof. W. M. Flinders Petrie.

THURSDAY, DECEMBER 17.

ROYAL SOCIETY OF ARTS, at 4.30.—The Indigo Industry: Dr. F. Mollwo Perkin.

INSTITUTION OF MINING AND METALLURGY, at 8.

INSTITUTION OF PETROLEUM TECHNOLOGISTS, at 8.—Notes on the Development of the Trinidad Oilfields: Prof. J. Cadman.

LINNEAN SOCIETY, at 5.—"Witches Brooms," caused by the Gall-mite, *Eriophyes triradiatus*, Nal., on *Salix fragilis*, illustrated by lantern-slides: M. Christy.—The Brent Valley Bird Sanctuary; An Experiment in Bird Protection: W. M. Webb.

FRIDAY, DECEMBER 18.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.

WIRELESS SOCIETY, at 8.—The High Frequency Resistance of Wires and Coils: Prof. G. W. Osborn Howe.

PHYSICAL SOCIETY, at 5.—Exhibition and Description of Some Apparatus for Class Work in Practical Physics: Dr. G. F. C. Searle.—A Vacuum Guard Ring and its Application to the Determination of the Thermal Conductivity of Mercury: H. R. Nettleton.

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